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*Editor*
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United States Air Force

*Assistant Editor*
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# Monthly Message

In the introduction to *A Doctor Speaks His Mind* by Roger I. Lee,* M. D., of Boston, there is this statement: "But I have great affection for the Hippocratic Oath, and I like to think of it as the conscience of the medical profession. I have faith in the profession and in its tradition of rugged individualism. I cherish a belief in the universality of the medical profession, and have hopes that because medicine is universal and the same all over the world irrespective of religion, race or language, it may play a large part in the ultimate peace of our world. We take a few glimpses at the past in the hope of a better understanding of the future."

This simple statement of the ideals of the medical profession and the universality of medicine as a great catalyst for peace is far more meaningful, as we think about it, than the rather cold cliche which so often appears: "The global war against disease."

In our economic aid to many nations since World War II we have assisted in the construction of laboratories, in epidemiology, in measures of public health and preventive medicine, in the erradication of malaria, and in safe water systems and sewage disposal. These are all of tremendous importance. We have neglected the direct approach to the people themselves, however; call it retail in character if you will. By that I mean the establishment in selected areas of modern hospitals and health centers with clinics attached. Over the years we have left these to various philanthropic, religious, and business interests: the Rockefeller Foundation; the Roman Catholic, Seventh Day Adventists, and Presbyterian churches, and other religions; and the oil companies. In recent years, under the personal inspiration and drive of such men as Dr. Schweitzer, Dr. Seagrave, and Dr. Thomas Dooley, single-handed measures of people-to-people good will and medicine have been carried forward, and now Dr. Dooley has obtained the backing of MEDICO (Medical International Cooperation).

Mr. John T. Connor, President of Merck and Company, has made two important addresses in which he emphasized the need for this type of direct medical assistance to the people of many countries. In my own travels through the Near and Far East, I have witnessed the same need for this type of aid and it has been expressed to me often by the medical professions in those countries.

The Soviets graduate annually large classes of physicians; they have offered, in some instances have built, hospitals in less developed countries, and have offered to supply the necessary personnel.

A high-minded and generous Iranian, Mr. Nemazee, as a measure of his gratitude to the people of America and Iran, personally installed a system of pure water in Shiraz, his home city, and also built a fine modern hospital there which has been operated for the past five years under combined American, Canadian, and Iranian staff.

Why should this government with its expenditure of vast sums in various countries fall behind and not realize the advantage of this type of people-to-people approach, which the President has emphasized.

Frank B. Berry

FRANK B. BERRY, M. D.
Assistant Secretary of Defense
(Health and Medical)

*Lee, R. I.: *A Doctor Speaks His Mind.* Little, Brown and Company, Boston, Mass., 1958. pp. v and vi.

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# Foreword

The *United States Armed Forces Medical Journal* is the medium for disseminating information of administrative and professional interest to all medical personnel of the Department of Defense. The Assistant Secretary of Defense (Health and Medical) and the Surgeons General of the several services invite all medical officers, dental officers, Medical Service Corps officers, Nurse Corps officers, and officers of the Veterinary Corps of the Armed Forces, and the medical consultants of the Army, Navy, and Air Force to submit manuscripts for publication in this *Journal*.

FRANK B. BERRY, M. D.,
*Assistant Secretary of Defense (Health and Medical).*

MAJOR GENERAL LEONARD D. HEATON,
*Surgeon General, United States Army.*

REAR ADMIRAL BARTHOLOMEW W. HOGAN,
*Surgeon General, United States Navy.*

MAJOR GENERAL OLIVER K. NIESS,
*Surgeon General, United States Air Force.*

UNITED STATES ARMED FORCES
MEDICAL JOURNAL

Volume X June 1959 Number 6

# THE DIAGNOSIS OF ASIAN INFLUENZA VIRUS INFECTION AFTER RECENT IMMUNIZATION

GARRISON RAPMUND, *Captain, MC, USA*
RICHARD T. JOHNSON, *Captain, MC, USA*
ANNIE S. BANKHEAD, *B. S.*
YAYE F. HERMAN, *M. S.*
OLIVER W. DANDRIDGE

THE antigenic composition of the Asian influenza virus, characterized by this and other laboratories in the spring of 1957, was found to vary radically from the Type A, A′, and swine strains of previous years.[1-3] Furthermore, serologic survey of the population at large showed that few people possessed antibody to the Asian variant[1,3] and emphasized the desirability of immunization prior to the fall-winter respiratory disease season. Widespread administration of monovalent Asian vaccine to military populations began in September 1957, coincident with the epidemic dissemination of the Asian virus in many areas. The antibody responses to the Asian influenza infection and to vaccination with this strain were incompletely studied, and it was not known how almost simultaneous infection and immunization would affect the immune response. To evaluate this problem a group of influenza patients, many of whom had been immunized shortly before disease, were studied in October 1957. It is the purpose of this report to describe the problems of serologic diagnosis of influenza in these patients and to compare the antibody responses observed in patients with or

From Department of Virus Diseases, Walter Reed Army Institute of Research, Washington, D. C. Capt. Rapmund is now assigned to U. S. Army Medical Research Unit, Institute of Medical Research, Kuala Lumpur, Malaya. Requests for reprints should be sent to Dr. Johnson, Walter Reed Army Institute of Research.

without previous vaccination to the response resulting from vaccination alone.

## METHODS AND MATERIALS

*Patients with influenza.* Between 8-28 October 1957, and coincident with the peak of the influenza epidemic in Washington, 48 patients were admitted to a special ward at Walter Reed Army Hospital with clinical influenza. Paired serums and throat washings were obtained from 42 of these patients. Patients were male, enlisted military personnel between the ages of 17 and 44 years. All were in good health prior to onset of present illness, and only 3 gave a history of pre-existing disease (2 with hepatic cirrhosis and 1 with bronchiectasis). All but 11 had received monovalent Asian influenza vaccine 4 to 40 days prior to onset of clinical influenza. The patients were hospitalized between the 1st and 8th day after onset (only 4 were admitted after the 4th day of disease) and were attended by one physician. Treatment consisted of bed rest only; no antipyretics or antibiotics were administered except to one patient who developed bacterial pneumonia on the 2d day of disease.

All patients had one or more of the following complaints on admission: cough, headache, myalgia, chills, feverishness, and sore throat. All were acutely ill and febrile with significant physical findings in the majority of patients limited to pharyngitis and conjunctivitis. In one patient pulmonary rales were heard on admission; three patients subsequently developed rales between the third and sixth days of disease. White blood cell counts on admission ranged from 3,800 to 18,000 per $\mu$l with a median value of 6,100 per $\mu$l. Roentgenograms of the chest were obtained on all patients on admission; evidence of pneumonia was found in the roentgenogram of only one patient. This unvaccinated patient was the only one with rales on admission, and as indicated above, had a concomitant hemolytic staphylococcal pneumonia in addition to proven influenza. No other complications were observed in the patients, and except for this patient with pneumonia, all patients were asymptomatic within two weeks of onset.

Acute serum specimens and throat washings were obtained on all 42 patients on admission (table 1). Serums were stored at -20°C and throat washings at -70°C until studied. Convalescent serums were obtained between the 13th and 30th days of disease in all patients except one on whom a convalescent serum was drawn on the 9th day of disease. Later convalescent serums, 5 to 10 weeks after onset of disease, were obtained from but 11 of 42 patients.

Serums from 47 normal volunteers were drawn before and three weeks after vaccination with monovalent Asian influenza vaccine in August 1957.[4]

TABLE 1. *Chronologic distribution of serum and throat-washings specimens from patients with clinical influenza, 1957*

| Vaccination status | Specimen | Number of patients with serums at indicated day of disease | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1-4 | 5-8 | 9-12 | 13-16 | 17-20 | 21-24 | 25-28 | 29-30 |
| Unvaccinated (Group I—11 patients) | acute serum and throat washing | 11 | | | | | | | |
| | convalescent serum | | | 1 | 8 | 1 | | 1 | |
| Vaccinated >3weeks prior to illness (Group II—11 patients) | acute serum and throat washing | 10 | 1 | | | | | | |
| | convalescent serum | | | | 9 | 2 | | | |
| Vaccinated <3 weeks prior to illness (Group III—20 patients) | acute serum and throat washing | 18 | 2 | | | | | | |
| | convalescent serum | | | | 17 | 1 | 1 | | 1 |

## Laboratory Studies

*Serologic tests.* Hemagglutinating antigens were simple infected allantoic fluids (table 2); each was prepared from low egg passage virus[1, 4–6] and was relatively insensitive to normal serum inhibitors. Untreated serums from each patient were tested

TABLE 2. *Antigens used for serologic diagnosis of influenza*

| Study group | Test and type of antigen | | |
|---|---|---|---|
| | HI* | CF | |
| | Allantoic fluids | V&S (Chorioallantoic fluids)** | S(Chorioallantoic fluids)*** V&S(Allantoic fluids)*** |
| Patients | A-PR8[5]<br>A-FLW-1-52[4]<br>A-Formosa 313-57[1] (4th egg passage)<br>B-IB1-50[6] | A-Japan 305-57[1]<br>B-Virginia 301-55[4] | A-Japan 305-57<br>B-Virginia 301-55 |
| Vaccine volunteers | A-Japan 305-57 (5th egg passage) | | A-Japan 305-57<br>B-Virginia 301-55 |

*Test[7] using human 'O' cells.

**CF test utilizing primary incubation of 75′ at 37°C.

***Modified CF test utilizing primary incubation of 16-18 hours at 4°C.

simultaneously for hemagglutination-inhibiting (HI) antibody by the method recommended by the Committee on Standard Serological Procedures in Influenza Studies.[7]

Two types of complement-fixing (CF) antigens were employed. The first (table 2) was prepared from infected allantoic fluids or saline extracts of infected chorioallantoic membranes by the method described previously.[1] Antigens titered 1:64/0.25 ml with 2 units of human antibody, the result of clinical infection, were infectious and possessed detectable hemagglutinin. They, therefore, were considered a mixture of "viral" and "soluble" (V&S) CF antigen. Purified "soluble" (S) CF antigen was made from similar saline extracts of infected chorioallantoic membranes from which infectious particles and hemagglutinins were removed by high speed centrifugation and adsorption onto human "O" cells. Briefly, 50 per cent suspensions of infected chorioallantoic membranes in buffered saline solution were subjected to repeated freezing and thawing, followed by two cycles of centrifugation; the first at 2,000 r. p. m. for 10 minutes, and the second in a model "L" Spinco centrifuge, using a No. 30 rotor, at 20,000 r. p. m. for 60 minutes. The upper two thirds of the resulting supernate was adsorbed with 1 per cent human "O" red blood cells at 37°C for 5 minutes, rapidly chilled, and centrifuged at low speed in a refrigerated centrifuge to remove red cells. The resulting supernate, which possessed a CF titer of 1:256, was devoid of detectable infectivity and hemagglutinin and constituted the purified "soluble" antigen. All antigens were stored at -20°C until used.

In the CF test with V&S antigen, serum (0.25 ml) was incubated with antigen (4 units in 0.25 ml) and complement (2 units in 0.5 ml) for 75 minutes at 37°C before the addition of the hemolytic system.[8] The CF test with S antigen and allantoic fluid V&S antigen differed from the above only in the primary incubation of serum, antigen, and complement, which was for 16 to 18 hours at 4°C.

All paired serums from the patients with clinical influenza on which a serologic diagnosis of Asian influenza infection was not established were tested for increases in adenovirus antibody using the RI-67 antigen previously reported by this laboratory.[8]

A fourfold increase in antibody titer was the minimum considered significant in CF or HI tests. All titers were expressed as the reciprocal of the initial serum dilution.

*Isolation of virus.* Throat washings, to which 1,000 units of crystalline penicillin G and 100 μg of streptomycin had been added per ml were inoculated into the amniotic (0.1 ml) and allantoic (0.1 ml) cavities of 9- or 10-day-old embryonated eggs.[9]

Allantoic and amniotic fluids were harvested after 48 to 60 hours' incubation at 35°C and tested individually for hemagglutinins. If no hemagglutinin was demonstrated, two additional passages of pooled fluids were made in eggs.

Throat washings which failed to yield virus after three blind passages in embryonated eggs were adsorbed with red cells in the attempt to concentrate virus. Two or more milliliters of throat washings were added to an equal volume of 1.0 per cent washed human "O" red blood cells, allowed to stand at room temperature for 5 minutes, chilled rapidly to 4°C, and centrifuged in the cold to remove the red cells. The red cell sediment was resuspended in 1.5 ml of Hank's solution[10] containing penicillin (1,000 units) and streptomycin sulfate (100 μg) and incubated at 4°C for 30 minutes before inoculation into embryonated eggs. Hemagglutinating agents were identified by the recommended technic.[7]

## RESULTS

### Diagnoses in Influenza Patients

The 42 patients have been divided into 3 groups. Group I consisted of 11 patients receiving no influenza vaccine within the year prior to their present illness. Group II consisted of 11 patients vaccinated subcutaneously with 200 CCA (chick-cell

TABLE 3. *Laboratory confirmation of 42 cases of clinical influenza in vaccinated and unvaccinated patients, 1957*

| Vaccination status | Number of patients | Pattern of serologic diagnosis | | | |
|---|---|---|---|---|---|
| | | HI & CF* positive | HI positive CF negative | HI negative CF positive | HI negative CF negative |
| Unvaccinated (Group I) | 11 | 9 (6)** | 0 | 1 (1) | 1 (1) |
| Vaccinated >3 weeks prior to illness (Group II) | 11 | 4 (3) | 4 (3) | 1 (0) | 2 (0) |
| Vaccinated <3 weeks prior to illness (Group III) | 20 | 6 (2) | 4 (3) | 2 (2) | 8 (4) |

*Fourfold or greater increase in antibody titer demonstrated.

**Figures in parenthesis represent number of patients from whom Asian Influenza virus was isolated.

agglutinating) units of monovalent Asian vaccine (Pitman-Moore) 21 or more days prior to their illness. Group III consisted of 20 patients similarly vaccinated from 4 to 19 days prior to their illness. Table 3 summarizes the results of serologic tests and attempts at isolation of virus from these patients.

*Unvaccinated patients (Group I).* A serologic diagnosis of influenza was achieved in 9 of 11 patients by HI test, and in 10 of 11 patients by CF test, with the V&S antigen. Significant HI or CF antibody increases were not demonstrated in the convalescent serum (17th day of disease) in one case. A late convalescent serum (38th day) obtained from this patient demonstrated a fourfold increase in both HI and CF antibodies. Thus, serologic proof of infection was obtained for each patient in this group. Influenza virus was isolated from the throat washings of 8 of 11 patients. While contributing nothing more to the frequency of diagnosis, virus isolations established a specific diagnosis of Asian influenza in one instance when the HI test was negative.

*Vaccinated patients (Groups II and III).* In vaccinated patients serologic diagnosis of influenza was more difficult to interpret, and fewer definitive diagnoses were made by serologic tests alone. Of 11 patients vaccinated 21 or more days prior to illness (Group II), fourfold increases in both HI and CF antibodies occurred in only 4 patients and virus was isolated from 3 of these (table 3). Four additional patients, virus isolated from 3, showed significant increases in HI but not CF antibody. In 1 other case, significant increase in CF antibody only was demonstrated. In the remaining 2 patients HI, CF, and virus isolation tests yielded no diagnosis.

In Group III (20 patients vaccinated less than 21 days prior to illness) fourfold increases in HI and CF antibody were demonstrated in but 6 patients. HI antibody alone increased in another 4, and the CF test alone provided 2 additional diagnoses. Thus, even fewer serologic diagnoses were obtained in this group. It is likely that the increases in HI antibody were due to infection, since virus was isolated from 5 of the 10 patients demonstrating HI antibody increases. Because of recent vaccination, however, HI test could not be used for diagnosis.

Because increases in CF antibody have been reported to occur only rarely following influenza immunization,[11,12] the CF test was used for the conclusive diagnosis of infection in this group. Fourfold or greater increases in CF antibody were demonstrated in only 8 of 20 patients. However, influenza virus was isolated from 7 of the remaining 12 patients who failed to show significant increases in CF antibody. Thus, in Group III, virus was isolated from 11 of 18 throat washings (61 per cent). Combining this finding with the 8 significant increases in CF antibody, Asian influenza was confirmed in 15 of 20 patients (75 per cent).

*Heterotypic and other antibody responses.* HI antibodies for PR-8, FLW-1-52, and IB1 were present in the acute and convalescent serums of all 42 patients. Fourfold or greater HI antibody increases to PR-8 were demonstrated in 3 cases, and to

FLW-1-52 in 2 cases. The magnitude of these heterotypic antibody increases was less than those shown to A-Formosa 313-57, and was independent of vaccination history. Similar heterotypic responses were observed by this laboratory during the winter of 1957 when fourfold or greater increases of HI antibody were demonstrated to PR-8 in 9 per cent and to FLW-1-52 in 3 per cent of patients at large with proved Asian influenza. No significant increases in HI or CF antibody to type B influenza virus or in CF antibody to adenoviruses were shown in the patients of this series.

*Effect of vaccination on recovery of virus.* Although the frequency of serologic diagnoses differs markedly among the three groups, the recovery of virus was not influenced by immunization. Asian influenza virus was isolated from 62 per cent of all patients (8/11 in Group I, 6/11 in Group II, and 11/18 in Group III); this is approximately the same percentage of isolations achieved by this laboratory in the routine diagnosis of Asian influenza during the same season. No additional isolations were achieved using the red blood cell adsorption method to concentrate virus particles.

TABLE 4. *Magnitude of HI and CF antibody increases in clinical influenza*

| Vaccination status | Number of patients | Antibody | Number of individuals showing indicated fold antibody increase | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 2 | 4 | 8 | 16 | 32 | 64 | 128 |
| Unvaccinated (Group I) | 11 | HI | 2 | 0 | 7 | 1 | 0 | 1 | 0 | 0 |
| | | CF | 0 | 1 | 5 | 2 | 2 | 0 | 0 | 1 |
| Vaccinated>3 weeks prior to illness (Group II) | 11 | HI | 1 | 3 | 3 | 2 | 2 | 0 | 0 | 0 |
| | | CF | 2 | 4 | 4 | 1 | 0 | 0 | 0 | 0 |
| Vaccinated<3 weeks prior to illness (Group III) | 20 | HI | 4 | 6 | 5 | 4 | 1 | 0 | 0 | 0 |
| | | CF | 3 | 9 | 6 | 1 | 1 | 0 | 0 | 0 |

*Effect of vaccination on serologic diagnosis.* Generally, the maximal titers of HI and CF antibody attained by the 35th day of disease in unvaccinated patients seldom exceeded 1:80 and were lower than those observed by others in the influenza A infections of previous years.[11] The fold-increases in antibody as measured by both tests in this group were similarly of low order (table 4) and only occasionally were greater than eightfold. In the vaccinated patients, maximal titers achieved by the 35th day were not greatly different from those in Group I. Because

acute phase serum titers of both HI and CF antibody tended to be higher in vaccinated individuals (table 5), increase in either antibody after infection was of lower order than in unvaccinated patients (table 4).

TABLE 5. *Influence of vaccination on antibody titers in acute serum*

| Vaccination status | Acute serum titer of | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HI antibody | | | | | CF antibody | | | | |
| | <5 | 5 | 10 | 20 | 40 | <5 | 5 | 10 | 20 | 40 |
| Unvaccinated (Group I) | 8 | 2 | | 1 | | 6 | 3 | 2 | | |
| Vaccinated >3 wks prior to illness (Group II) | 1 | 4 | 3 | 3 | | | 3 | 4 | 4 | |
| Vaccinated <3 wks prior to illness (Group III) | 6 | 2 | 6 | 5 | 1 | 3 | 6 | 7 | 3 | 1 |

The failure to demonstrate a significant CF antibody increase in 18 of 31 (58 per cent) and of HI antibody in 13 of 31 (42 per cent) of vaccinated patients (Groups II and III, table 3) was unexpected and was not readily explained. Two explanations seemed possible. First, antibody response may have been incomplete by the 30th day after infection. Accordingly, late convalescent serums were obtained from patients of Groups II and III upon whom no serologic diagnosis had been made with sera obtained between 13 and 30 days after onset. In none of 10 patients with convalescent serums obtained between 67 and 72 days after onset were further significant increases or decreases in HI or CF antibody demonstrated.

Second, the antibody evoked by vaccination may have prevented demonstration of further increases resulting from infection. Inasmuch as most patients exhibited the minimal antibody increase considered significant (fourfold) of infection (table 4), it might not have been possible to show further increase in antibody required for diagnosis. Table 6, which summarizes the results of all 42 patients, clearly shows that the success or failure of serologic tests in the diagnoses of Asian influenza was influenced by the acute serum antibody titer. Thus the frequency with which serodiagnoses were made by HI or CF test decreased with increasing acute serum titer.

It remained to be shown that higher titers of HI and CF antibody observed in the acute serums of vaccinated patients were indeed the result of vaccination. That HI antibodies are evoked

by vaccination with Asian influenza vaccine is a well documented phenomenon.[4,13] The data presented in table 5 suggested that Asian influenza vaccine induced CF antibodies to the combined V&S antigen used. Since CF antibody resulting from immuni-

TABLE 6. *Influence of antibody titer in acute serum on subsequent serologic diagnosis*

| | Acute serum titer of: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HI antibody | | | | | CF antibody | | | | |
| | <5 | 5 | 10 | 20 | 40 | <5 | 5 | 10 | 20 | 40 |
| Number of patients with acute titer | 15 | 8 | 9 | 6 | 4 | 9 | 12 | 13 | 7 | 1 |
| Number who had subsequent 4-fold or greater increase | 14 | 6 | 6 | 2 | 2 | 9 | 8 | 5 | 1 | 0 |
| Decimal fraction with subsequent 4× or > increases | 0.93 | 0.75 | 0.66 | 0.33 | 0.50 | 1.00 | 0.75 | 0.38 | 0.14 | .00 |

zation is said to be evoked primarily by the V antigen,[11] serums from the 18 patients in Groups II and III without significant CF antibody increases were tested with the purified S antigen to determine whether acute serum titers would be lower. Simultaneous tests with V&S antigen (allantoic fluid) were also performed. In 5 of the 18 serum pairs a fourfold increase in antibody to the S antigen was demonstrated. However, in 6 of the same 18 serum pairs a fourfold increase in antibody to the combined V&S antigen was demonstrated. Inasmuch as 13 of the 18 patients had already shown a *twofold* increase in CF antibodies in the initial test (table 4), the fourfold increases shown in 6 patients on repeat testing may be accounted for by the increased sensitivity of the CF test resulting from overnight incubation of serum and antigen. Acute serum titers obtained with the S antigen were not significantly lower than those found using the combined antigen, suggesting that considerable antibody to S antigen was produced by vaccination. That this was actually the case was established by study of 47 pairs of serum drawn from military volunteers who received by a subcutaneous route 0.5 ml of vaccine containing 250 CCA units of virus per milliliter.

The HI and CF antibody responses resulting from the administration of 250 CCA units of vaccine were studied. This dose

is comparable to that received by the patients in this study.* The incidence of fourfold or greater increases in CF antibody following vaccination (4 per cent) was less than the incidence of significant HI antibody increases (51 per cent). However, titers of CF antibody following vaccination were essentially the same whether measured by V&S or S antigen (table 7), and

TABLE 7. *HI and CF antibody response to vaccination in 47 volunteers given 250 CCA units of Asian influenza vaccine*

| Serum | Number of volunteers showing indicated titers of: | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HI antibody | | | | | | CF antibody | | | | | | | |
| | | | | | | | V & S | | | | S | | | |
| | <5 | 5 | 10 | 20 | 40 | 80 | <5 | 5 | 10 | 20 | <5 | 5 | 10 | 20 |
| Pre-vaccination | 21 | 15 | 11 | | | | 24 | 15 | 8 | | 24 | 10 | 11 | 2 |
| Post-vaccination (3 weeks) | 6 | 3 | 17 | 10 | 9 | 2 | 14 | 18 | 14 | 1 | 12 | 16 | 12 | 7 |

a twofold increase in CF antibody was demonstrated in 38 per cent (18 of 47) tested with the V&S antigen and in 49 per cent (23 of 47) tested with the S antigen. In a situation where antibody response to infection is low, antibody response to immunization even of a twofold magnitude might obscure what otherwise would be a fourfold increase in antibody, diagnostic of infection. Because of the high frequency of antibody to S antigen following immunization, the use of the CF test was of no value in differentiating immunization response from response to infection with Asian influenza virus.

## DISCUSSION

Widespread disease with the new antigenic variant of influenza brought with it problems in laboratory diagnosis. Prior to the Asian influenza epidemic, it was shown that the general population had a striking lack of previous experience with the new

*The quantity of soluble antigen need not be the same in vaccines having the same CCA unit content but purified by different methods. The soluble antigen in the 250 CCA unit vaccine (Sharples purification technic) administered to the volunteers cited above was found to titer 1:4 in the presence of 2 units of human convalescent antiserum; the soluble antigen in the 200 CCA units vaccine (eluate purification method) administered to the majority of patients in this study was found to titer 1:16 in the presence of 2 units of human convalescent antiserum. Higher levels of CF antibody to soluble antigen would be expected in the sera of individuals immunized with the latter than with the former vaccine. If individuals in both groups were infected with influenza virus soon after immunization, fewer diagnoses with the CF test would be anticipated in the group receiving the vaccine containing the high titer of soluble antigen.

virus.[1,14] The magnitude of antibody response to infection with a virus of new antigenic configuration (Asian influenza virus) might be less than the response induced by infection with older strains (A, A′, or B influenza virus), and in the fall of 1957 when this "virginal" population was exposed to the Asian virus, this low magnitude response was confirmed.

The patients in this study represented a small homogeneous group; clinically all had influenza and no difference in clinical disease was noted between the vaccinated and unvaccinated patients. They were in the vanguard of influenza cases, and it can be assumed that none had prior experience with the new antigen, except in some cases by vaccination. Despite the low magnitude of antibody response to infection, serologic diagnosis was highly successful in unvaccinated patients with influenza infection, and the HI and CF tests were of equal efficacy. In the patients vaccinated greater than 3 weeks prior to onset of illness, it seemed unlikely that HI antibodies due to immunization alone would develop in the interval between acute and convalescent sera. However, when results of the HI test were considered in this group the serologic procedures yielded fewer diagnoses. In the group vaccinated less than 3 weeks prior to onset of disease the HI test results could not be considered, and the CF test demonstrated so few significant antibody increases that isolation studies had to be relied upon for the majority of diagnoses.

The reasons for this failure of serologic technics in the diagnosis of Asian influenza infection following immunization were not due to the poor timing of convalescent serums, since the early convalescent serums drawn 9 to 26 days after onset of illness yielded a serologic diagnosis in 10 of 11 unvaccinated patients, and no additional diagnoses were obtained in 10 vaccinated patients from whom late convalescent serums were drawn. The failure of the serologic tests seemed related to vaccination.

Immunization with the Asian vaccine may elicit antibody yet fail to protect against disease. This antibody may seriously interfere with the serologic diagnosis of influenza infection in immunized patients. It has been shown that the failure to demonstrate antibody increases was due in part to the CF and HI antibody titers in the acute serum and that the use of purified "soluble" CF antigen did not reduce these titers. However, the dual stimuli of infection and immunization would be expected to produce higher CF and HI antibody titers in the convalescent serum than were demonstrated. One may speculate that infection with the Asian influenza virus during the period of antibody response to vaccination may have caused an inhibition of antibody production by any of several mechanisms, none of which can be substantiated by the data at hand.

The majority of people have now been exposed to the new variant of influenza. If past experience with influenza is repeated, the Asian family of type A influenza will probably show minor antigenic alterations as did the A family[14] when in 1952 the FM1-47 subgroup was replaced by the Scandinavian '53 subgroup and again in 1956 when the Dutch '56 subgroup became prevalent. Under these circumstances further epidemics of infection with the Asian strains would be expected to yield antibody responses analogous to those produced by infection with other type A influenza viruses, where the high magnitude of response facilitates serologic diagnosis. The CF test under these circumstances might be able to differentiate meager CF antibody response to immunization from marked response to infection. However, marked antigenic shifts of type A influenza virus similar to that which occurred in 1957 will undoubtedly take place, giving rise to future epidemics in the virgin population. At that time, last fall's race between the rapid spread of the new virus and the production and administration of vaccine for the control of disease will be repeated. At this time, a repetition of these problems in the laboratory diagnosis of influenza can be anticipated.

## SUMMARY

Forty-two cases of clinical Asian influenza virus infection occurring during the immunization program and at the onset of the 1957 influenza epidemic were studied to evaluate the efficacy of laboratory technics for the diagnosis of Asian influenza. CF and HI tests yielded a high percentage of positive diagnoses in nonimmunized patients, but neither serologic test proved effective in the diagnosis of influenza in those patients who developed the disease shortly after immunization. Isolation of the virus from throat washings was found to be of value in establishing the diagnosis in immunized patients, but this procedure was effective in less than two thirds of the cases of influenza. The failure of serologic diagnosis in recently immunized patients was shown to be due in part to the low magnitude of antibody response to infection with the new variant combined with the development of both CF and HI antibodies in response to immunization. The use of the purified "soluble" antigen to differentiate antibody elicited in response to infection from antibody elicited in response to vaccination was found to be of no value, since the Asian vaccines contained significant quantities of "soluble" CF antigen. Studies on volunteers who received vaccine in the summer of 1957 confirmed these findings. The possible future antibody responses to infection with Asian type influenza viruses and the probable recurrence of these problems in the diagnosis of influenza are discussed.

ACKNOWLEDGMENTS: The authors are indebted to Captain Everett Cooper, MC, USA, Walter Reed Army Hospital, for the clinical information and assistance in obtaining specimens from the patients, and to Captain Frederick J. Flatley, MC, USA, and Dr. Maurice R. Hilleman who obtained serums from the volunteers.

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## DANGERS OF ANTIBIOTIC THERAPY

It is my opinion that the three major hazards of antibiotic therapy are anaphylactic reactions, superimposed staphylococcic infections, and blood dyscrasia. Although many of the antibiotics have been incriminated in all of these hazards, the evidence suggests that serious and often fatal anaphylactic reactions are most common after the administration of procaine penicillin G by the intramuscular route; serious and often fatal superimposed staphylococcic infections, largely a problem in hospitalized patients, are due at least in part to the widespread use of the broad-spectrum antibiotics; and serious and often fatal blood dyscrasia occurs most frequently after the administration of chloramphenicol. —Wallace E. Herrell: Hazards of Antibiotic Therapy. *Journal of the American Medical Association*, December 6, 1958.

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# EFFECTIVENESS OF INFLUENZA VACCINES DURING AN EPIDEMIC OF ASIAN INFLUENZA

BENJAMIN F. GUNDELFINGER, *Commander, MC, USN*
W. T. STILLE, *M. S.*
JOSEPH A. BELL, *M. D., Dr. P. H.*

THE identification of a new antigenic variant of influenza virus of the A group from epidemics occurring in the Far East in April and May, 1957,[1,2] permitted a revision in the antigenic composition of influenza vaccines before their anticipated use during the fall and winter. The new Asian viruses were found to be sufficiently different antigenically from previously known influenza viruses of the A type to indicate that vaccines containing the older antigens might provide little if any protection against illness due to the new strain. By early summer of 1957, it was evident that the Asian strain of influenza was being disseminated throughout the world, and influenza epidemics were expected. Since vaccination is the only practical method known for the control of influenza, great efforts were made to prepare and distribute influenza vaccines containing the new antigen.

In June, 1957, influenza outbreaks occurred aboard ships of the United States Atlantic Fleet operating out of Newport, Rhode Island, and at a Navy installation in California.[3] Because of the continual interchange of Navy personnel between duty stations, it was expected that a summer or early-fall epidemic might occur at the United States Naval Training Center, Great Lakes, Illinois. Therefore, a controlled study was initiated on July 1, 1957, to determine whether or not a commercially prepared inactivated monovalent Asian-strain influenza vaccine would prevent the epidemic disease. It was also considered desirable to determine whether or not a polyvalent influenza vaccine that

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From the United States Naval Medical Research Unit No. 4, United States Naval Training Center, Great Lakes, Illinois (Research Project NM 52 05 04), and the United States Department of Health, Education, and Welfare, Public Health Service, National Institute of Allergy and Infectious Diseases, Laboratory of Infectious Diseases. Comdr. Gundelfinger, former officer-in-charge, Naval Medical Research Unit No. 4, is now assigned to Preventive Medicine Division, Bureau of Medicine and Surgery, Department of the Navy, Washington, D. C.

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had been in use in the military services during the winter of 1956-57 and did not contain antigens derived from the Asian strain of influenza virus would provide any protection against or modification of Asian influenza.

A sharp epidemic of influenza occurred in early October, 1957, at Great Lakes, Illinois. Although the vaccine evaluations were initiated on July 1, only the men entering the study between August 10 and September 21 were under observation during the epidemic. These men constitute the study population of this report. The results of these observations indicate that a high degree of protection against influenza during the epidemic was provided by the monovalent Asian-strain influenza vaccine, and suggest that some protection may have resulted from the use of the polyvalent influenza vaccine.

## MATERIALS AND METHODS

### Vaccine A

Approximately 30 per cent of the incoming recruits were given a 1-ml. subcutaneous inoculation of monovalent influenza-virus vaccine (A/JAPAN/305-57) reported by the manufacturer* to contain 200 CCA (chick-cell-agglutinating) units per milliliter. Two separate lots of this vaccine were used. The first lot was prepared by concentration of the virus contained in chick-embryo allantoic fluid a calculated twenty-two times by ultracentrifugation and inactivation by ultraviolet irradiation. Thimerosal, 1:10,000 solution, was added as a preservative. The second lot was prepared in a similar fashion, and adsorbed on calcium phosphate. Since the analysis of results yielded no evidence of a difference in protection against illness between the groups of men receiving the two lots of vaccine, no further distinction between the lots is made

### Vaccine B

Another approximate 30 per cent of the incoming recruits were given a 1-ml. subcutaneous inoculation of polyvalent influenza vaccine containing 250 CCA units each of formalin-inactivated A/Swine, A'/FM1 and B/GL/1739-54 viruses. This vaccine had been used by the armed forces during the winter season of 1956-57.

### Control

The remaining approximate 40 per cent of the incoming recruits were given an inoculation of material not containing influenza vaccine. A formalin-inactivated trivalent vaccine* con-

*Parke, Davis and Company.
**Kindly supplied by Eli Lilly and Company, Indianapolis, Indiana.

taining antigens of Types 3, 4 and 7 adenoviruses was also being evaluated in this population. Thirty-three per cent of the men inoculated with vaccine A and 32 per cent of those inoculated with vaccine B were also inoculated subcutaneously with 1.0 ml. of the trivalent adenovirus vaccine. Thirty per cent of the control group received the adenovirus vaccine, and the other 70 per cent a placebo inoculation of formalin-maintenance medium 199. Since the three groups receiving either vaccine A or vaccine B or a noninfluenza inoculation were similar in the proportion of men in each group who also received the adenovirus vaccine, any differences observed in the illness experience would be due presumably to the action of the influenza vaccines. Therefore, the men who did not receive an influenza vaccine are considered as controls for the men who received either vaccine A or vaccine B. An analysis of the adenovirus-vaccine evaluation will be the subject of a separate report.

The inoculations were given by personnel of the Medical Research Unit three or four days (or more when weekends and holidays intervened) after the arrival of the men at Great Lakes. The inoculation each man received was determined by a random-selection process so that about 30 per cent, 30 per cent and 40 per cent of the men were assigned to the vaccine A, vaccine B and control groups, respectively. Neither the recruits nor the administrative and medical personnel of the Recruit Training Command had any knowledge of the study vaccine status of a particular man during his nine weeks of recruit training. A total of 450 men were excluded from this study because they did not choose to participate, claimed to be sensitive to fowl products or were detained over a week in their pretraining processing for various administrative or medical reasons. Thus, the study population consisted of 3355 Navy recruits who arrived at Great Lakes between August 7 and September 18, 1957, and who were not excluded for the reasons stated above. At its maximum strength of 3355 men the study population was somewhat less than half the total number of recruits in training. After the completion of inoculations by the Medical Research Unit on September 21, all further non-egg-sensitive incoming recruits were subsequently inoculated with an Asian strain of influenza-virus vaccine. These, together with recruits arriving before August 7, are not included in the study.

Recruits in training may attend the infirmary at their option. A record is kept of each visit or report to the infirmary. The reported illness experience of the study population was classified by a review of these official records. Each illness was classified as respiratory or nonrespiratory on the basis of the information contained in the infirmary records or by a medical officer's diagnosis in hospitalized patients. Many men reported

to the infirmaries several times with similar illnesses. These reports were considered manifestations of one illness episode if they occurred within seven days of a previous report for a similar illness. The following was noted for each illness episode: the maximum temperature recorded during the episode; the duration; the number of reports; and whether hospitalization was required. Respiratory illnesses were classified as febrile or afebrile depending on whether the maximum recorded temperature during the illness was greater or less than 100°F. by mouth. Hospitalized patients with respiratory illnesses were included in the febrile category since only on a rare occasion did such a patient have a temperature less than 100°F. by mouth. Because of the unreliability of distinguishing between influenza and some other acute respiratory disease on clinical grounds, no attempt was made to classify these illnesses further. A period of about two weeks has been thought to be required before an influenza vaccine could be expected to afford protection. Therefore, illnesses in the vaccine and control groups were classified as occurring either less or more than two weeks after inoculation.

## RESULTS

Figure 1 shows the reported rates for febrile respiratory illness in each vaccine group during each week of the study period of August 10 to November 9, excluding illnesses reported within two weeks of vaccination. The populations at risk averaged about 50 men per group for the first week and about 170 men per group during the week ending September 7. Then, the populations increased to an average of about 1000 men per group by the week ending October 12, after which they declined to about 500 per group by the week ending November 9. The highest rates of illness were noted during the weeks ending October 5 and 12. At this time, all other major population groups at Great Lakes experienced elevated rates of hospitalizations for respiratory illness, many of which were the highest since records were kept by this unit (since 1948).

Paired serum specimens were obtained from a few recruit patients of the control group who were hospitalized for respiratory illness and were titrated by the complement-fixation test to the Asian strain of influenza virus (A/JAPAN/305-57). The pairs showing fourfold or greater titer rises increased from 54 per cent early in September (13 pairs) to 67 per cent in the last week of September (9 pairs) and to 100 per cent for the first week of October (10 pairs). Influenza viruses antigenically similar to the Asian strains were isolated from throat specimens of men who showed rises in influenza antibody titer.

Table 1 shows the total reported illness experience, by vaccine group, for the entire period of the study. Analysis of the data relating to the occurrence of febrile respiratory disease two weeks or more after inoculation reveals that 964 such illnesses were reported during the study period from August 25 to November 9. Of these cases 152 occurred in men who were

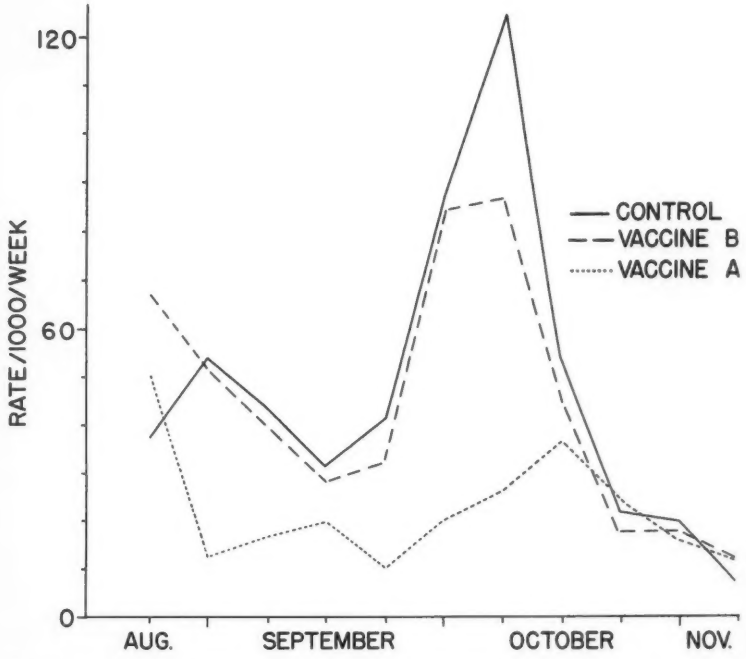


*Figure 1. Reported attack rates of febrile respiratory illness two or more weeks after inoculation, according to calendar week (vaccine A=monovalent Asian strain, and vaccine B=polyvalent non-Asian strain).*

inoculated with vaccine A, 299 were reported by men who received vaccine B, and 513 were reported by men in the control group. This gives an attack rate of 23.5 per 1000 per week in the vaccine A group, 49.7 per 1000 per week in the vaccine B group, and 58.9 per 1000 per week in the control group. A measure of the effectiveness of the vaccine was calculated in relation to the control and found to be 60 per cent for vaccine A and 16 per cent for vaccine B. The effectiveness of the vaccines in reducing hospitalized respiratory disease under the conditions of this study was measured as 68 per cent and 34 per cent for vaccines A and B respectively.

TABLE 1. *Reported illnesses by vaccinated and control Navy recruits*

| Status | Influenza-vaccine group | | | | | |
|---|---|---|---|---|---|---|
| | A | | B | | Control | |
| | No. | Rate/1000/wk. | No. | Rate/1000/wk. | No. | Rate/1000/wk. |
| Total study period (Aug. 10 to Nov. 9, 1957): | | | | | | |
| Respiratory illness: | | | | | | |
| Febrile | 216 | 16.9 | 390 | 32.7 | 650 | 37.1 |
| Hospitalized | 93 | 7.3 | 168 | 14.1 | 355 | 20.3 |
| Afebrile | 365 | 28.5 | 280 | 23.5 | 404 | 23.1 |
| Nonrespiratory illness | 234 | 18.3 | 223 | 18.7 | 287 | 16.4 |
| Total no. of men at risk* | 984 | | 916 | | 1347 | |
| Total period, exclusive of data for 1st 2 wk. postinoculation (Aug. 25 to Nov. 9, 1957): | | | | | | |
| Respiratory illness: | | | | | | |
| Febrile | 152 | 23.5 | 299 | 49.7 | 513 | 58.9 |
| Hospitalized | 67 | 10.4 | 129 | 21.4 | 284 | 32.6 |
| Afebrile | 254 | 39.4 | 210 | 34.9 | 295 | 33.9 |
| Nonrespiratory illness | 148 | 23.0 | 153 | 25.4 | 203 | 23.3 |
| Average no. of men at risk/wk. | 586 | | 547 | | 792 | |
| Period of Sept. 29 to Oct. 12, 1957, exclusive of data for 1st 2 wk. postinoculation: | | | | | | |
| Respiratory illness: | | | | | | |
| Febrile | 34 | 19.4 | 148 | 90.0 | 268 | 113.3 |
| Hospitalized | 13 | 7.4 | 64 | 39.0 | 171 | 72.4 |
| Afebrile | 71 | 40.6 | 68 | 41.4 | 85 | 36.0 |
| Nonrespiratory illness | 32 | 18.4 | 41 | 25.0 | 57 | 24.1 |
| Average no. of men at risk/wk. | 874 | | 822 | | 1182 | |

*Total number of men initially in study population 1017, 946, and 1392 respectively in each group. Since study was terminated on November 9, while 360 men remained in training, for 1 or 2 more weeks, number of men at risk proportionally reduced.

In the last weeks of September and early October rates of respiratory illness showed a sharp increase in all populations at Great Lakes, recruits as well as seasoned personnel. Concurrently, laboratory evidence of influenza was readily available. The weeks ending October 5 and October 12 are noteworthy for the highest attack rates observed in the past eight years at Great Lakes. Table 1 also shows the illness experience by vaccine group for these two weeks. The effectiveness of vaccine A and vaccine B in reducing febrile respiratory disease in relation to the control was found to be 83 per cent and 21 per cent respectively. For hospitalized patients with respiratory disease, the relative effectiveness was 90 per cent for vaccine A and 46 per cent for vaccine B.

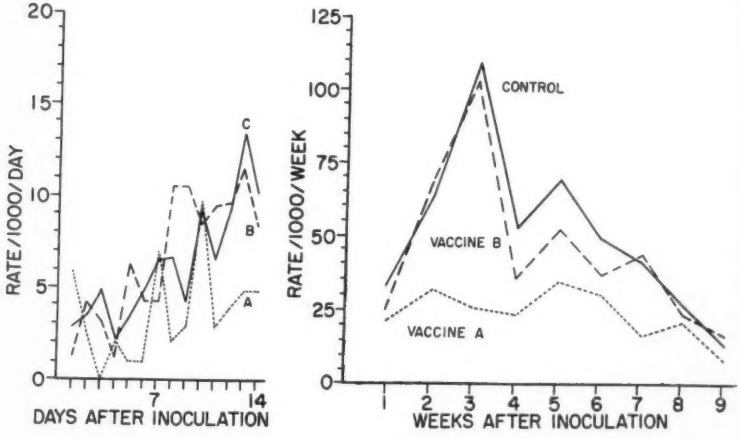


*Figure 2. Reported attack rates of febrile respiratory illness, according to time from inoculation.*

Rates for the reporting of febrile respiratory illness are shown on a daily basis for the first two weeks after inoculation and also weekly for the entire period men were at risk in figure 2. The group receiving vaccine A reported considerably less illness ten days after inoculation. This group also reported somewhat less illness, on the average, in the first ten days after inoculation. The group receiving vaccine B reported illness in a manner quite typical of the control group. Although the average relative reduction in reporting illness in this group was not great, it appeared that some men were benefited by this vaccine.

## DISCUSSION

In a previously reported study of vaccinated and unvaccinated human volunteers with challenge-induced Asian influenza, 78

per cent of the control group had a febrile respiratory illness, and a 44 per cent reduction in such illness was associated with vaccination.[4] On the basis of virus isolation, serologic evidence, clinical picture and incubation period, these illnesses were regarded as almost entirely due to the Asian strain of influenza virus contained in the challenge material. At Great Lakes, about half the control group reported at least one febrile respiratory illness during the study period. Undoubtedly, additional illnesses were unreported.

The occurrence of Asian-influenza infections was demonstrated by the isolation of viruses and by the results of serologic tests throughout the entire period of the study. No evidence of influenza B infections was obtained. Laboratory evidence of the occurrence of infections with Type 4 adenovirus and Group A beta-hemolytic streptococci was also obtained during the study. In spite of a mixture of potential pathogens, a maximum relative reduction of 83 to 90 per cent was associated with the use of the monovalent Asian strain of influenza vaccine (vaccine A). Possibly, the conditions of military training—that is, grouping of men in one age group in common housing, messing and classroom facilities—provide conditions of contact approximating those of the afore-mentioned study. Under such conditions, the Asian-influenza vaccine appeared to be highly efficacious in preventing naturally occurring influenza, apparently having some beneficial effect shortly after inoculation and a decided effect after ten days. These results agree with those reported from other studies.[5,6]

It is interesting that the vaccine contained only 200 CCA units per milliliter. A vaccine of considerably greater CCA unitage was desired, but could not be obtained under the emergency conditions prevailing during the summer and fall of 1957. The good protective results with this vaccine suggest that the CCA unitage is only a crude index of the potency of a vaccine.

It appears that at least a small percentage of the population benefited from a vaccine containing strains other than the Asian type. Although maximum protection was associated with the use of a vaccine containing inactivated Asian-strain virus, the results of these observations indicate that prior experience with other influenza-virus antigens may provide some protection, suggesting some immunologic similarity between the Asian strain and other, previously prevalent, influenza viruses. This study supports the generally accepted belief that antigens derived from a strain of influenza virus homologous with the epidemic strain are an essential component of an influenza vaccine of maximum prophylactic effectiveness.

SUMMARY

An epidemic of respiratory illness, associated with Asian influenza, occurred in early fall of 1957 at the United States Naval Training Center, Great Lakes, Illinois. A vaccinated and control-study population of 3355 Navy recruits in training, as well as other populations, were affected. During the epidemic, 83 to 90 per cent reduction in febrile respiratory illness was associated with prior inoculation with a monovalent Asian-influenza vaccine containing only 200 CCA units of A/JAPAN/305-57-strain virus. A similar 21 to 46 per cent reduction was associated with prior inoculation with a polyvalent influenza vaccine not containing the Asian strain. Although a marked protective effect was noted as early as ten days after inoculation, a slight beneficial result was noted before that time. No untoward reactions to the vaccine were observed. It is concluded that the Asian-influenza vaccine was highly efficacious under the conditions of use at Great Lakes in the fall season of 1957.

ACKNOWLEDGMENT: We are indebted to Captain Carl E. Bull, USN, commanding officer, Recruit Training Command, and Captain A. M. Ecklund, MC, USN, director, Medical Department, United States Naval Training Center, Great Lakes, Illinois, for their co-operation and to Dr. F. M. Davenport, director, Commission on Influenza, Armed Forces Epidemiological Board, for his continued interest in this study and for providing some of the Asian-influenza vaccine.

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In the period 1947 through 1955 deaths of passengers while in flight on American scheduled airlines ranged from seven a year to twenty. Of 41,623,000 passengers carried in 1955, only 18 died in flight. The United States Air Force has now successfully evacuated over 2,000,000 patients by air. These data emphasize the medical safety of air travel. —M. Frederick Leeds: Medical Aspects of Commercial Jet Air Travel, *California Medicine,* April 1959.

# USE AND VALUE OF THE STEP TEST IN MILITARY PILOT SELECTION

EDGARD EVRARD, *Lieutenant Colonel, Medecin, Belgian Air Force*

IN December 1948 the step test was introduced into the medical examination given to young men applying for admission as student pilots in the Belgian Air Force. For nine years this test was given to all candidate student pilots without considering the test results in the final decision of candidates' fitness or unfitness for flight duty. In addition, this test was used in routine medical examinations of a group of student pilots during their stay at the flying training school. Finally, a limited number of jet fighter pilots on active duty were tested by this method.

Previous reports,[1-4] contain the preliminary results of these studies. The final evaluation of the results in 3,329 subjects is presented in this article. Subjects were grouped as follows: (1) 3,174 young men, between the ages of 17 and 24, examined at the time of their application as student military pilots (2,301 of these were declared fit for flight training); (2) 114 student pilots, between the ages of 17 to 26, tested at the end of advanced training, before going on to operational fighter squadrons; and (3) 41 fighter pilots, between the ages of 20 and 27, actively engaged in jet flying.

The procedure established at the Harvard Fatigue Laboratory[5-7] has undergone several variations but that described by Brouha, Graybiel, and Heath[5] in 1943 was employed. This procedure also was used in 1945 by Malmejac, Dugue, and Voisin[8] on 113 candidate student pilots at the selection center of the French Air Force at Algiers, and was recommended in France by Grandpierre[9] in 1947.

Briefly, as described by Brouha, Graybiel, and Heath,[5] the step test consists in having the subject step up and down a 20-inch platform 30 times a minute for 5 minutes, unless he stops from exhaustion before then. The pulse is counted from 1 to 1½ minutes, 2 to 2½ minutes, and 3 to 3½ minutes after completion of the step test. The score is obtained by dividing the duration

From the Medical Service, Belgian Air Force, Brussels, Belgium. Col. Evrard is the director of medical services.

of exercise by the sum of pulses in recovery according to the formula:[7]

$$\text{Index} = \frac{\text{Duration of exercise in seconds} \times 100}{2 \times \text{sum of pulse counts in recovery}}$$

## STATISTICAL DATA

### Pilots Actively Engaged in Jet Flying

Table 1 presents the results of the step test administered to 41 jet pilots between 20 and 27 years of age. These pilots had a step test index equal to or above the score of 72.

According to the classification set forth by the Harvard Fatigue Laboratory,[5-7] the pilot's physical condition is to be considered as excellent, good, or average. The step test was applied impromptu during the course of an annual physical examination of the flying personnel and no difficulty was experienced.

TABLE 1. *Results of step test administered to 41 fighter pilots*

| Step-test index | Number of pilots | Total according to Harvard nomenclature |
|---|---|---|
| 72 to 74 | 5 | Average: 17 (41%) |
| 75 to 79 | 12 | |
| 80 to 84 | 10 | Good: 13 (32%) |
| 85 to 89 | 3 | |
| 90 to 94 | 9 | Excellent: 11 (27%) |
| 95 to 99 | 1 | |
| 100 to 104 | 1 | |

### Student Pilots at Flying Training Schools

The results in 114 student pilots, 17 to 26 years old, who had spent 6 to 12 months of training in flying schools, are shown in table 2. The step-test index of these young pilots, several weeks before their transfer to operational fighter squadrons, was below 75 in only 10 per cent. The lowest index of all was 69 (only one case). All of the student pilots, therefore, were classified as excellent, good, or average. Their distribution into these three categories was about the same as that of the fighter pilots.

### Candidate Student Pilots

Results are reported on 3,174 male Belgian subjects aged 17 to 24 years (table 3). If it is true that this is a preselected group, inasmuch as they were volunteers, they were, nevertheless representative of healthy young Belgians. In fact, this group included athletes, nonathletic individuals who had never participated in sports, intellectuals, technicians, workers, college

TABLE 2. *Results of step test administered to 114 student pilots*

| Step-test index | Number of student pilots | Total according to Harvard nomenclature |
|---|---|---|
| 69 | 1 | |
| 70 to 74 | 11 | Average: 46 (40%) |
| 75 to 79 | 34 | |
| 80 to 84 | 26 | Good: 43 (38%) |
| 85 to 89 | 17 | |
| 90 to 94 | 13 | |
| 95 to 99 | 6 | |
| 100 to 104 | 1 | |
| 105 to 109 | 2 | Excellent: 25 (22%) |
| 110 to 114 | 1 | |
| 115 to 120 | 1 | |
| 120 and over | 1 | |

TABLE 3. *Results of step test administered to 3,174 candidate student pilots*

| Step-test index | Number | Total according to Harvard nomenclature (per cent) |
|---|---|---|
| 60 to 64 | 50 | Weak: 2 |
| 65 to 69 | 213 | |
| 70 to 74 | 462 | Average: 44 |
| 75 to 79 | 726 | |
| 80 to 84 | 618 | Good: 34 |
| 85 to 89 | 447 | |
| 90 to 94 | 317 | |
| 95 to 99 | 153 | |
| 100 to 104 | 96 | |
| 105 to 109 | 39 | |
| 110 to 114 | 26 | |
| 115 to 119 | 7 | |
| 120 to 124 | 4 | Excellent: 21 |
| 125 to 129 | 4 | |
| 130 to 134 | 3 | |
| 135 to 139 | 3 | |
| 140 to 144 | 4 | |
| 145 to 149 | 0 | |
| 150 to 160 | 2 | |

and university students, students of technical schools, young officers, noncommissioned officers and military personnel of the Army or ground personnel of the Air Force.

The analysis of this particular distribution shows that (1) the index was below 75 in 23 per cent of the candidates, compared with 10 per cent for student pilots and fighter pilots; and (2) the index was below 70 in 8 per cent of the total number of candidates.

Not all of these 3,174 candidates were declared physically fit. For administrative reasons, 451 candidates were not admitted to training. Of those who were allowed to enter pilot training, many were not successful for various reasons. Lack of flying proficiency disqualified the greatest number: 1,061 candidates; 852 others were dropped because of physical unfitness upon the initial medical examination; 103 were killed; 60 were dropped because of medical reasons (such as airsickness, sequelae of accidents, and illness during training; 21 were dropped at the time of the step test; and 43 were dropped for disciplinary reasons. Of the original 3,174 candidates, 583 became jet pilots.

### Leg Length and Height-Weight Ratio

Before making any interpretation of the statistical data, it seemed necessary to make sure that the step-test index is not influenced by body build.

Subjects for this study were pilot candidates, between 1.62 m and 1.95 m in height and between 55 kg and 90 kg in weight. The measurement of the length of their legs was a functional one. The technic described by the Royal Air Force manual, *"The Medical Examination for Fitness for Flying"* was used.[10] The subject is seated against a wall, legs outstretched. Length of the legs is the distance between the wall and the soles of the feet. All candidates should have legs equal to or longer than 100 cm.

The study was carried out on 1,672 subjects with regard to the height-weight ratio and on 1,663 subjects of the same group with respect to leg length (nine records failed to present an exact measurement).

Statistical calculations demonstrated that the height-weight ratio and leg length have no significant influence on the results of the step test, within the limits described here. Because of the lack of a sufficient number of subjects, it was not possible to collect data on subjects having legs shorter than 100 cm.

## CLINICAL AND PSYCHOLOGIC DATA

Before stating positively that the step test should be included in the routine medical examination for flying fitness, it seems

logical to make certain that the step test involves no risk for a normal subject, candidate pilot or student pilot, because of the intensity of effort required to perform it.

**Effort Required During the Step Test**

The step test is a severe test. In the large majority of cases, however, the test did not seem to require any effort which could overtax a young and healthy subject. In 21 pilot candidates (0.6 per cent) in mediocre physical condition, eliminated at the time of their initial medical examination, it was deemed advisable to stop the test after three minutes because of the sudden appearance of objective manifestations of exhaustion. The test is performed easily during the first three minutes even by subjects in poor physical condition. When, during the last two minutes, the test becomes too exhausting, the first sign of exhaustion is the subject's difficulty in following the rhythm set by the metronome.

Cureton and associates[11] carried out measurements of different respiratory, circulatory and metabolic factors on American Olympic champions while they were performing several types of exercises and during the rest period afterward. Their results showed that the five-minute step test gave results almost identical to those obtained during a run on a treadmill, on a horizontal plane, at a speed of 10 miles per hour for 3 minutes 57 seconds. The distance run at this speed corresponded to 1,073 meters in 3 minutes 57 seconds. In confirmation of these data, athletic tests administered to pilot candidates of the Belgian Air Force had shown us that classifications according to the step-test index generally agreed with results obtained in a race of 1,500 meters in 5 minutes 45 seconds. The effort expended in the five minutes of this test thus does not exceed that which might be expected of a subject in good health.

*Cardiac rate.* Cardiac rate gives an indirect means of evaluating the effort required by the step test. The rate recorded at the beginning of the second minute after completion of the five-minute step test, that is to say, after one minute of rest, is compiled in table 4 for a group of 543 of our subjects. The heart rate is also shown in these same subjects, after one minute of rest, on completion of a three-minute step test.

Slonim, Gillespie, and Harold[12] reported on results of exhaustion tests given in 1956 to 50 subjects, aged 18 to 25 years, candidates for naval aviation training in the United States Navy. The technic used was a run at a speed of 3.5 miles an hour on a treadmill at an incline varying from 10 to 28 per cent. The mean and extreme rates per minute were noted as follows:

| | After 4 min. | After 5 min. | After 6 min. |
|---|---|---|---|
| Mean rate/minute | 182 ±7.5 | 186 ±7.7 | 188 ±7.9 |
| Extremes of rate | 168-198 | 170-201 | 174-204 |

During the tests a syncope occurred in one of their subjects after 5 minutes 40 seconds; his rate was 196 at the fifth minute. Ventricular extrasystoles were noted during exercise in three of their subjects whose cardiac rates were between 184 and 190.

As shown in table 4, the most rapid cardiac rates noted in our subjects evaluated by the step test, after one minute of rest, were still far from those around 190 which caused collapse and exhaustion, according to the observations of Slonim and his colleagues.[12] If it is estimated that 10 beats are the mean de-

TABLE 4. *Cardiac rate in 543 subjects after completion of step tests*

| Cardiac rate per minute | Number of subjects | |
|---|---|---|
| | 5-minute step test | 3-minute step test |
| 67 - 70 | 2 | 9 |
| 72 - 80 | 0 | 30 |
| 81 - 90 | 13 | 46 |
| 91 - 100 | 20 | 73 |
| 101 - 110 | 61 | 101 |
| 111 - 120 | 132 | 134 |
| 121 - 130 | 135 | 91 |
| 131 - 140 | 102 | 43 |
| 141 - 150 | 58 | 13 |
| 151 - 160 | 17 | 3 |
| 161 - 170 | 3 | - |

celeration occurring during the first minute of rest, it can be shown that the rate in almost all subjects would not exceed 170 at the end of the step test. Under the same conditions, the rate would not exceed 160 a minute in 96 per cent of the subjects. This gives us additional support for deciding that for a young subject in good health the step test, in spite of its severity, does not come near the limits which might cause acute and serious exhaustion. Finally, aside from the 21 young men eliminated for medical reasons, step tests in the remaining 3,308 subjects were carried out without mishap or incident.

*Electrocardiographic tracings.* Electrocardiographic tracings have been recorded on 100 subjects under the following conditions: (a) with subject lying down, before the step test; (b) 1 minute after the test; (c) 2 minutes after the test; (d) 3 minutes

after the test; and (e) 10 minutes after the test. The three standard limb leads and the sixth precordial lead were recorded. Standard leads I and III were taken each time for a period of 30 seconds, standard lead II and the sixth precordial lead were taken for 10 consecutive seconds. The results are as follows: All tracings showed characteristics of the electrocardiogram recorded after exercise: (a) lowering of the amplitude of $P_1$; (b) increase in that of $P_2$ and $P_3$; in some cases a lowering of the amplitude of $P_2$ or *status quo;* (c) reduction in amplitude of $T_1$; (d) increase in amplitude of $T_2$; (e) eventual straightening out of $T_3$ negative; and (f) reduction in duration of auriculoventricular conduction time and of intraventricular conduction, and reduction of Q-T duration. Ten minutes after the end of the test, these reductions still remained in varying proportions according to the subjects.

Very often, a downward curving of the S-T segment, especially in lead II and lead III, was found. This curving sometimes lasted during four to six contractions, disappeared, then returned in similar short episodes during the following minutes. A few anomalies were revealed in this group of 100 electrocardiograms:

1. In one subject, auricular extrasystoles appeared after effort. Duration of the QRS complex increased after the step test and still remained elongated with respect to the amount of rest, 10 minutes after the end of the test. There were seen, respectively, values of 0.075 seconds at rest for a rate of 50; 0.09 seconds after 1 minute for a rate of 76; and 0.085 seconds after 10 minutes for a rate of 64.

2. In another subject, ventricular extrasystoles appeared during the third and fourth minute after exercise. The QRS complex was not modified.

3. In another subject who, at rest, presented fluctuations of the automatic center or Wenckebach periods, these episodes disappeared after the step test and did not reappear ten minutes after the step test. So is demonstrated the benign meaning of the phenomenon.

4. In one subject, the appearance of a nodal rhythm was seen which was maintained from the second to the fourth minute after the step test, then disappeared.

5. In four subjects, during the first four minutes after the step test, a lengthening of the QRS was seen for a few episodes of five to six contractions. Duration of the QRS, however, never exceeded 0.12 seconds. In the tracing taken at the tenth minute this lengthening no longer existed. In any event, if one agrees with Schellong[13] that shortening of the QRS complex after exertion is an accurate test of the integrity of the myocardium and, that

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the first sign of fatigue of the cardiac muscle is precisely the elongation of intraventricular conduction time after effort, one is justified in stating that the step test induced this sign of cardiac suffering only five times out of 100 cases. In addition, it was noted that one subject who, while resting, showed signs of myocardial disturbance of rheumatic origin, perfectly withstood the test without any other symptom of cardiac change having been manifested by the test. Such results, objectively controlled by the electrocardiogram, confirm the innocuousness of the test in a young subject in normal physiologic condition, the few anomalies shown being only functional and transitory.

Next, the direction of the mean electrical axis of QRS before the test and during the 10 minutes following the step test was analyzed. Segers and his associates[14] reported that, in the morphology of the electrical complexes, the most striking peculiarity revealed in all the long distance runners whom they examined was a much more marked deviation of the electrical axis toward the right than that in the average tracings taken on normal sedentary subjects.

In the 100 tracings reported here the direction of the electrical axis during rest, before the step test, then during the 10 minutes after the test was observed. Table 5 shows data relative to the direction of the electrical axis on 100 subjects at rest. It is seen than 50 per cent of the subjects at rest had a mean electrical axis of QRS with a direction beyond plus 70 degrees.

Immediately following the step test a rotation of the axis toward the right by 10 degrees or more in 84 cases, and absence of axis rotation in 16 cases were found. For the 84 cases, maximum rotation was found: (1) on the tracing taken after one minute in 58 cases (69 per cent); (2) on the tracing taken after two minutes in 19 (22.6 per cent); and (3) on the tracing taken after three minutes in 7 (8.4 per cent).

Return toward the condition of that during rest was done in a progressive manner, minute by minute, but was not completed after 10 minutes in most cases. A tracing taken in "hyperpnea" at rest before the test, in 40 cases, showed that hyperpnea causes either a lack of rotation or a rightward rotation of varying degree, but the rotation consecutive to the step test was clearly more marked than that during hyperpnea at rest.

Comparison of the degree and direction of axis rotation after the step test with the score of the step-test index, anomalies of the tracings and the athletic habits of those concerned, led us to the following conclusions:

1. A maximal deviation to the right, existing at the very beginning of the second minute after the end of the step test and re-

turning progressively toward the direction found during rest, was encountered in trained athletes and in subjects having a high index of cardiac tolerance to physical exertion. All of the subjects in this category had a step-test index above 78.

2. A rotation to the right where the maximum is reached only at the third minute after the end of the step test coincides in 50 per cent of the cases with low indices (average, weak, mediocre or doubtful) and almost always in subjects who declared that they participated in no sport.

3. A rotation toward the right where the maximum deviation was attained only during the fourth minute after the end of the step test was seen in six cases. This occurred in three subjects with an index of mediocre value; in one subject with an elongation of QRS; and in one subject with the appearance of nodal rhythm between the second and fourth minute of the step test. It seems, therefore, that this maximum slow rotation could be a sign of difficulty in cardiac adaptation to intense physical exertion or of a pathologic condition.

TABLE 5. *Direction of electrical axis for 100 subjects*

| Direction of electrical axis (in degrees) | Number of subjects |
|---|---|
| -10 to 0 | 2 |
| 0 to 29 | 4 |
| 30 to 39 | 7 |
| 40 to 49 | 4 |
| 50 to 59 | 15 |
| 60 to 69 | 18 |
| 70 to 79 | 20 |
| 80 to 89 | 16 |
| 90 to 99 | 11 |
| 100 to 109 | 0 |
| 110 to 119 | 3 |

4. Absence of rotation toward the right after the test occurred in subjects who were clinically in good condition but who said they practiced no sport and whose athletic activity was at a minimum.

5. A rotation toward the right where the maximum deviation was shown at the very beginning of the second minute after the step test, but where the axis did not return to the left during the next ten minutes, was found in trained athletes (cross-country runners). In this case, it was accompanied by a good step-test index. In cases where this axis location was accompanied by an index denoting mediocre or doubtful tolerance to exertion,

subjects stated that they participated neither in a sport nor in physical training. Thus it appears that, whatever the explanations which may be given to these statements, the nature of the modifications which supervened in the direction of the axis, during the period of recuperation after the test, constitutes an important factor for the evaluation of cardiac aptitude to exertion, and that that element should be taken into account as well as the score of the step-test index.

### Motivation

The test requires an effort of increasing will, mainly beginning with the third minute. Thus, it is absolutely necessary that the test be carried out under psychological conditions of an elimination test, that is to say, the subject should be sufficiently motivated to continue his effort. The test is to be performed only by subjects, such as pilot candidates or pilots who are scheduled for medical checkup, where the test result is important in the admission to or continuation of a career in athletics, or aviation, for example.

## DISCUSSION

On the basis of statistical data, the object of this study was to determine whether or not the step test should be included as part of the medical examination for flying. Use of the step test could be justified only if it were shown that this test sets the minimum level of endurance and cardiovascular adaptation to the many factors or conditions imposed in flying. These would include hypoxia, rapid acceleration in flight, variations in temperature, necessity to bail-out, and stresses imposed by operational fatigue. In this case, it is important to set a score below which elimination of the candidate would be required because of the risks of failure involved.

Use of the step test could be justified also if it were proved that cardiac tolerance to physical exertion, shown by the step-test index, is related to successful instruction and training of the student pilot.

*Does the step test allow us to set a minimum level of cardiac tolerance to flying stress that should be required of the candidate pilot?* In this respect it seems logical to demand of the candidate, at the very beginning of his career, an endurance reserve that is sufficient for the performance of his duties and that can be maintained at a normal level. According to the studies of Cureton and associates[11] on American Olympic athletes in 1948, the step-test index was high in the case of all athletes in competition where endurance was needed, such as swimmers of 200-meter, 400-meter and 1,500-meter races, and long- and medium-distance runners. Studies by the same author showed that, among

28 athletic sports, the mile run was the one that gave the best individual measure of endurance (r = 0.708), and possessed the highest value for prediction of form (r = 0.924).

Cureton and associates[11] found a statistical correlation of 0.54 after preliminary training in the step test and in the mile run. The step test corresponds most nearly to the 1,500-meter run for the physiologic factors involved and is justified, therefore, as a measurement of a pilot's endurance.

In this study statistical data relative to jet pilots and student pilots established that the step-test index of 70 is the lowest possible limit of cardiac tolerance for exertion for jet pilot training, according to the criterion of a satisfactory physiologic condition.

First of all, it was proved that subjects having an index below 70 comprised more than 16 per cent of the group of candidates eliminated at the time of the initial examination for reasons of a clinical nature other than a deficiency of vision or hearing, and more than 13 per cent of the category of subjects declared fit at the time of that examination but eliminated later, during their training, for medical reasons. Such figures indicate the care the examining physician must exercise in physical examinations of those subjects having such a low step-test index as, in at least one case out of six, there will be evident symptoms of a poor physiologic condition incompatible with flight training.

Among the 140 subjects whose index fell below 70, and who were eliminated at the initial medical examination for a reason other than that of a deficiency of vision or hearing, we found, most often, sequelae of pleurisy, pulmonary tuberculosis, neurasthenia, moderate hyperthyroidism, functional or organic diseases of the heart and vascular system, diseases of the kidneys, very marked insufficiency in strength. All these subjects, in spite of their physical unfitness, had been given the step test for experimental purposes.

By statistical calculation, an attempt was made to determine to what extent an index below 70 is linked to the increase in the number of eliminations during training and to the number of fatal flying accidents. According to the chi square method that was used, the following conclusions were reached: (1) The initial medical examination eliminates a percentage of candidates with a step-test index below 70 that is significantly higher than the general proportion of the whole group. (2) Among the group of 1,850 candidates admitted to training, the category, that later gave evidence of a physical deficiency that can lead either to elimination or that can explain some fatal flying accidents, has a significantly greater number of trainees with an index below 70 than the group as a whole.

Lowering the limit of the step-test index below 70 results in a significant increase in the number of students killed during training and a significant increase of eliminations for medical reasons during training.

Among the 122 students who had an index below 70, however, and who were admitted to flying training, 32 (26%) went on to become successful pilots. The question then arises as to whether these 32 pilots might not still have a certain handicap despite the fact that they barely passed the different elimination tests. For 19 of them, we have the results of a step test given three to four months after their admission to the elementary flying training school. Eighteen subjects reached an index above 70 and one subject an index of 69 at that time. It is apparent that some young subjects, in doubtful physical condition at the time of the initial medical examination but who are clinically fit, can improve their physical condition in a few months at the elementary flying training school.

The following practical conclusions were drawn from the statistical data:

1. Subjects with a step-test index below 70 should be screened very carefully by medical examiners at the time of their initial physical examination. Those who, after a thorough medical examination, show no illness or deficiency or sequelae of an illness indicating unfitness on a clinical basis still have a reasonable chance of becoming pilots because of the possibility of appreciable improvement of this physiologic condition in the training period. These are a category of "doubtful" cases. Consequently, these candidates should be considered as temporarily unfit or kept under very close medical supervision until they attain the step-test index of 70, after appropriate physical training.

2. Subjects with an index of 64 or below no longer meet the conditions for fitness and adaptation to intense strain sufficiently. They should be eliminated at once for their chances of becoming physically fit are too uncertain.

For the specific purpose of the medical examination for flying fitness, seven categories of cardiovascular tolerance to strain connected with flying have been established, category one being that of "excellent" subjects. The details are given in table 6.

*Does the step test have any relation to success in pilot training?* A minimum level of cardiovascular tolerance to strain linked with flying has been set in order to assess flying fitness. Does a higher degree of cardiovascular tolerance have a favorable bearing on the psychomotor aptitudes necessary for success in pilot training? In other words, is the champion athlete more

likely to complete the flying school course successfully than the applicant with a normal or merely sufficient degree of endurance? Graybiel and West,[15] in experiments with 1,076 U. S. Navy pilots undergoing flight training, found that within the limits of physical fitness in the group under study, differences

TABLE 6. *Categories of cardiovascular tolerance to strain, for fitness for flying*

| Categories | Cardiovascular tolerance | Step-test index |
|---|---|---|
| 1 | Excellent | 90 and over |
| 2 | Good | 80 - 89 |
| 3 | Average good | 75 - 79 |
| 4 | Average weak | 72 - 74 |
| 5 | Mediocre | 70 - 71 |
| 6 | Doubtful | 65 - 69 |
| 7 | Insufficient | 64 and below |

in degree of physical aptitude, measured specifically by the step test, the pack test and by other physical tests, have no relationship to success in flying. Of 1,000 students finishing primary training, 10 (1 per cent) had step-test scores between 60 and 69. These authors, although not setting the exact limit of minimum cardiac tolerance, did conclude that "from the results it is apparently unnecessary to maintain superior levels of physical fitness during the training stages."

If our classification of seven categories (table 6) is used for the 583 subjects who graduated and for the 1,061 eliminated during training because of professional deficiency, it is obvious that the chances of success are not greater for subjects having a high degree of cardiac tolerance. The percentages for fit and unfit student pilots in each category are extremely close (table 7).

The findings thus confirm those of Graybiel and West[15] and establish that: (1) Above a certain minimum threshold of physiologic condition, at an index value of 65, success or failure in flying training cannot be predicted from the degree of cardiac tolerance to strenuous physical exertion in which this tolerance alone can be measured; (2) It is not necessary to seek very high levels of physical endurance during training of the pilots. However, the minimum physiologic condition required at the beginning of the jet pilot candidate's career should correspond at least to an index of 70.

*Use and value of the step test during flight training in the routine medical examination.* By using the step test at fixed intervals, it is possible to control the effect of a military train-

ing program on the physiologic level while pilots are at the flying training school or are serving in squadrons. A group of 166 student pilots took the step test at the time of their selection examination and after a stay of six months at the flying training school. The results are shown in table 8. It is easy to understand the value of the information so collected by the medical service for a periodic check of the physiologic condition of the flyers.

TABLE 7. *Fit and unfit student pilots in each category of cardiac tolerance*

| Categories | Fit | | Unfit because of professional deficiency | |
|---|---|---|---|---|
| | Number | Per cent | Number | Per cent |
| 1 | 123 | 21.1 | 225 | 21.1 |
| 2 | 189 | 32.4 | 353 | 33.2 |
| 3 | 150 | 25.7 | 248 | 23.2 |
| 4 | 68 | 11.6 | 125 | 11.7 |
| 5 | 21 | 3.6 | 42 | 3.9 |
| 6 | 32 | 5.4 | 63 | 5.9 |
| 7 | - | 0 | 5 | 0.16 |

TABLE 8. *Changes occurring in the step-test index after six months for 166 student pilots*

| Categories | Improved category after six months | Same category after six months | Lower category after six months |
|---|---|---|---|
| 1 | - | 14 | 12 |
| 2 | 16 | 22 | 9 |
| 3 | 23 | 14 | 10 |
| 4 | 13 | 5 | 2 |
| 5 | 5 | - | 2 |
| 6 | 16 | 1 | - |
| 7 | 2 | - | - |

The step test was not given pilots aged 28 years or more. In the routine medical examination, less exhausting and strenuous tests are more appropriate to check the physical condition of jet pilots in operational squadrons.

## CONCLUSIONS

Conclusions drawn from the study of the statistical and clinical data, on the use of the step test in the assessment of aircrew fitness, are as follows:

1. The use of the step test is justified as an elimination test at the initial medical examination of a candidate pilot. The test sets the minimum threshold of cardiac tolerance required of candidate military pilots at that time.

An index value of 70 provides a sufficient guarantee as to the degree of cardiac tolerance in subjects previously considered qualified by other clinical tests in the medical examination for flying fitness.

A higher proportion of fatal accidents and a higher proportion of eliminations for medical reasons during training occurred in subjects whose index fell between 65 and 69.

An index below 65 should lead to immediate elimination. An index between 65 and 69 should lead at least to temporary unfitness until the subject can reach a score of 70 or more.

The ECG tracings recorded immediately after the step test only rarely show some slight signs of cardiac insufficiency. These are transitory ones. Rotation of the mean QRS axis during the test is one of the factors to be considered in the assessment of cardiac tolerance.

2. The step test is not justified as a classification test. The step-test index has no relationship to the specific aptitudes for flying, that is, it has no value in predicting success or failure in pilot training.

3. The step test enables the medical examiner to follow variations in cardiac tolerance to physical exertion during various phases of flight training.

## SUMMARY

The step test was given to 3,329 young Belgians. Study of the statistical and clinical results show that the test is justified as an elimination test at the initial medical examination. The step test is not justified as a classification test for predicting success or failure in flight training.

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## CHAIN REACTION OF SERENDIPITY

An 18-year-old Scottish chemist named William Henry Perkin was trying to synthesize quinine from coal tar more than a century ago when, while washing the black mess from his test tubes, he was alert enough to determine that there was history's first important artificial dye. That find led to a chain reaction of serendipity: the dye's "accidental" use as an essential stain for bacteriological study; the unplanned birth of organic chemistry; and the surprise development of a wide variety of medicinal compounds including atabrine, aspirin, and the sulfonamides. The original sulfonamide had lain idle on research shelves for years because it was considered only a dye base.—Milton Golin: Serendipity—Big Word in Medical Progress. *The New Physician*, November 1958.

# AN EXPERIMENTAL STUDY OF "PHYSICAL FITNESS" OF AIR FORCE PERSONNEL

BRUNO BALKE, *M. D.*
RAY W. WARE, *Captain, USAF (MC)*

MODERN highly civilized life has almost completely removed the necessity for greater physical effort. Automation in labor, in transportation, and in many activities of daily living has greatly reduced the need for previously required physical exercise. As a consequence, the great functional reserves of the human organism, provided by nature, may become seriously affected since the organs are readily adaptable to changes of functional demands. Regular physical activity enlarges metabolic, circulatory, and respiratory reserves while inactivity has the opposite effect. Although high functional reserves have never been found to be undesirable, the sedentary man insists that he can easily live without them. It is not known, however, to what extent the reserves may diminish through the years without ill effect on the man's well-being, and not much is known about the normal range of capacity for coping with increased metabolic demands. No standards of "physical fitness" are established yet because "fitness" has never been clearly defined and, therefore, is not measurable.

It is generally understood that a high level of "physical fitness" enables a person to meet strenuous physical demands with the least strain of functional effort and with fewer consequences of physical fatigue. Inasmuch as the physiologic reactions to work are measurable and a determination of the functional limitations is possible with a sufficient degree of accuracy, an appraisal of the physical performance capacity of an individual appears to be feasible. Work capacity could be defined as the highest level of metabolic load which can be compensated for adequately by optimal co-ordination of the functional reserves. This definition of work capacity is based on the experimental evidence that in gradually increased work a point will eventually be reached at which definite physiologic limitations result in a failure to adequately meet further metabolic requirements. These functional limitations may be of a cardiovascular, respiratory, metabolic, or hormonal nature.

From Department of Physiology-Biophysics, U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas.

The most objective criterion of work capacity, as defined, is the maximal oxygen consumption as a measure of circulatory and respiratory adaptability. On the basis of this criterion Åstrand[1] determined the work capacity of a large group of persons and correlated the results with sex and age. His experimental group was composed mainly of Swedish physical education students and the results of the study reflect, accordingly, a relatively high level of performance capacity. In a clinical study, Luft[2] determined the physical competence of male outpatients, 20 to 45 years of age. All were in good health according to rigorous clinical standards, but not accustomed to occupational or recreational physical exercise. The results, therefore, reflect a relatively low level of work capacity.

To fill an existing gap in knowledge and to obtain more information about the normal range of man's physical performance capacity, a study was initiated to screen the work capacity of a large population. This report presents the experimental results of the first series of investigation of about 500 male military and civilian Air Force personnel.

## METHOD

The method of screening work capacity developed in this laboratory has proved a useful tool in evaluating changes in work capacity brought about by changes in physiologic or environmental situations.[3-5] The test on the treadmill or ergometer bicycle begins with light work requiring an energy expenditure of not more than four times the resting rate. That is accomplished, on the treadmill, by walking at a speed of 90 meters per minute (or at 3.3 m. p. h.) on a horizontal level. Every minute a light load is added by elevating the treadmill angle 1 per cent. The increase of work intensity is so gradual that functional adaptations take place within a few seconds. Thus, there is hardly any difference between the functional values measured during any given minute of this test and the values measured during "steady state work" at comparable gradients.

The adaptive functional response to the gradually increased metabolic requirements is assessed by cardiovascular and respiratory measurements. Previous studies[4] have shown that attainment of a pulse rate of 180 beats per minute may serve as the critical cutoff point of this test. Although maximal work capacity usually reaches well beyond this point, there are sufficient physiologic indications to validate this criterion as a useful measure of the aerobic crest load. A continuation of work beyond this point is, in most instances, not paralleled by further adequate functional adaptation. Work, then, becomes increasingly anaerobic.

The maximal oxygen intake measured at the cutoff point of this testing procedure is generally somewhat lower than the values determined by the usual procedure wherein work of six

minutes' duration at a constant maximal load is used. However, it might more closely represent the maximal oxygen intake which can be maintained for longer periods of time and, therefore, may express more appropriately the capacity for sustained work.

In a relatively small number of cases the test cannot be carried on to a pulse rate of 180 beats per minute. Occasionally, obvious respiratory limitations or a nonreversible reduction of the blood pressure amplitude occur at lower pulse frequencies and serve as indications to terminate the test. In men of advanced age the maximal pulse frequency rarely reaches 180 beats per minute.[6,7]

## PROCEDURE

After arrival at the laboratory the experimental subjects were accustomed to walking on the treadmill until their stride became normal and relaxed. They answered a short questionnaire as to age, rank, present job, previous and present physical activities, smoking habits, and whether or not they favored a regular physical training program. Weight and height were measured and the subjects were then readied for the test.

Pulse rate and blood pressure measurements were taken before and after the test at sitting rest, and while walking on the treadmill during the second half of each minute. Determinations of the respiratory gas exchange during work were made at regular intervals. The work intensity was gradually increased by elevating the treadmill angle 1 per cent each minute.

## RESULTS

For quick orientation, the test duration in minutes, identical with the final treadmill grade in per cent can serve as a readily available criterion of work capacity. On the basis of this criterion the test results from about 500 subjects were plotted. As shown in figure 1, persons in the poorest physical condition attained a critical pulse rate of 180 beats per minute as early as the seventh or eighth test minute, the average performance centering around the fifteenth and sixteenth minute; and some persons, in excellent physical condition, were able to last longer than 23 minutes before reaching the cutoff point. Exceedingly well trained athletes (members of the U. S. Pentathlon Team) set the highest marks with 27 and 28 minutes.

Using the measurements of the gas exchange during the test work, the average metabolic requirements for the gradually increased work were superimposed on the graph as oxygen consumption per kilogram of body weight per minute in order to demonstrate the correlation between the test duration and the physiologic demands of the corresponding loads.

### Cardiovascular Response

Of all the physiologic functions measured, the pulse rate at any given workload reflected most closely the status of the work capacity of a person. Figure 2 illustrates the pulse response

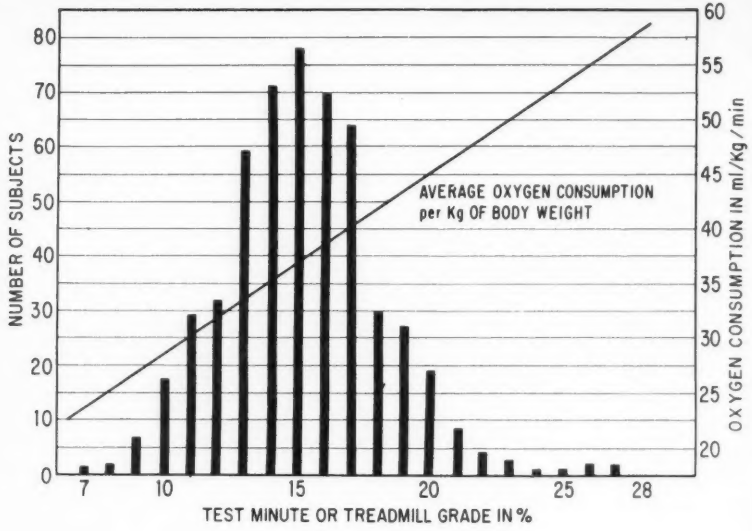
NUMBER OF SUBJECTS
OXYGEN CONSUMPTION IN ml/Kg/min
AVERAGE OXYGEN CONSUMPTION
per Kg OF BODY WEIGHT
TEST MINUTE OR TREADMILL GRADE IN %

*Figure 1. General distribution of work capacity of 530 men based on critical test duration or treadmill elevation, and related to the maximum oxygen consumption.*

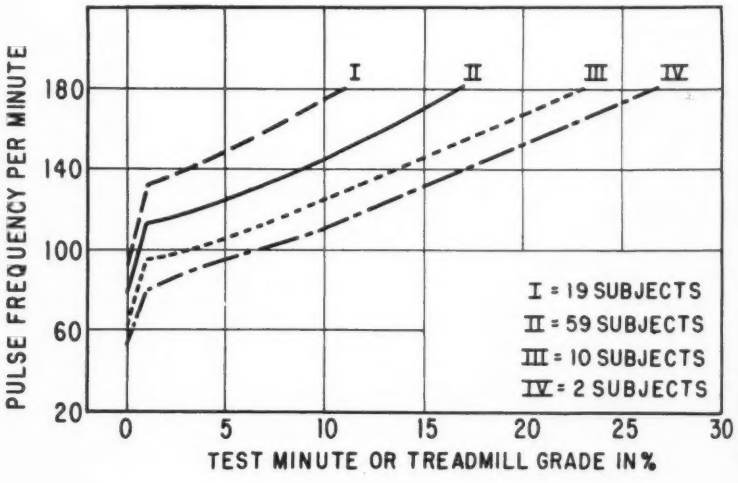


*Figure 2. Pattern of typical pulse response to gradually increased demands during the work capacity test. Groups I through IV represent very poor, fair, very good, and superior "physical fitness," respectively (see table 1).*

patterns of four groups of persons: the work capacity of group I was classified as "very poor," that of group II as "fair," that of group III as "very good," and that of group IV as "superior." There was a considerable overlapping of the individual values at the lower workload levels; hence, the use of any pulse rate below 180 beats per minute as a critical cutoff point for determining work capacity appears less reliable. Most individuals not accustomed to strenuous physical effort display a variety of reaction patterns in their functional adaptation to gradually increasing work until they approach cardiovascular limitations.

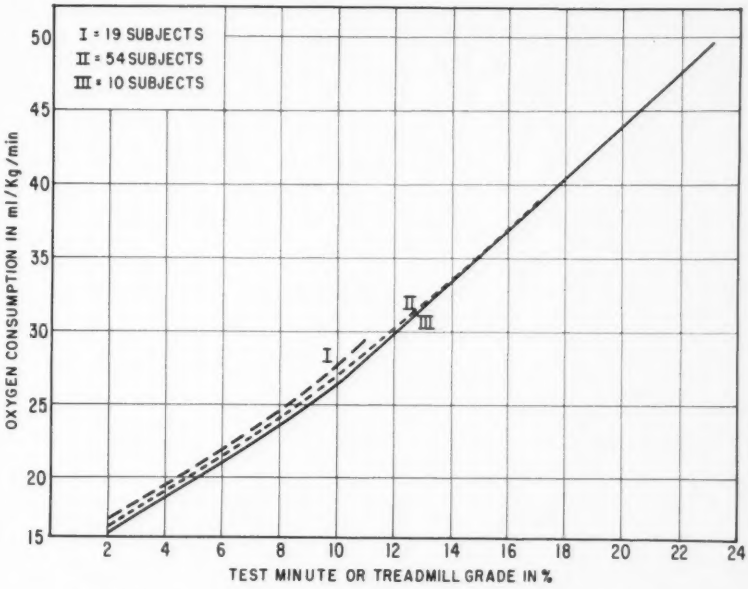


*Figure 3. Average oxygen consumption (per unit of body weight) during the work capacity test. The work efficiency of the group in "very poor" condition (I) appears to be only little less than that of the "fair to good" (II) or the "very good" group (III).*

When blood pressure values, observed at the various work intensities, were averaged and plotted, certain trends became apparent: the persons with lower work capacity had, on the average, higher systolic as well as higher diastolic pressures at comparable loads than persons with higher physical performance capacity. The maximal systolic pressure, however, was for all groups almost identical. Despite these apparent trends, the use of the blood pressure as a criterion for individual differentiation of work capacity is unsatisfactory because of the tremendous overlapping of the individual values. The only statement that can be made with some degree of validity is that high diastolic pressures (100 mm Hg and above) usually designate low levels

of work capacity, while very low diastolic pressures (from 60 mm Hg down to zero) are most likely to be observed in persons with high performance capacity.

### Oxygen Consumption

One might assume that a person's work efficiency (that is, the amount of oxygen consumed per unit of body mass at a given workload) would be of valuable assistance in determining work capacity. Such a criterion, however, was found to be impractical. Although group averages revealed a noticeable trend toward slightly decreased oxygen intake as performance capacity increased (fig. 3), the overlap of individual values excludes the general use of this criterion in individual evaluation of work capacity. In fact, the real differences in the efficiency of walking are so small from man to man, and the correlation between work intensity and oxygen requirement per unit of body mass is so well established, that one is able to predict a person's total oxygen intake for a known work intensity. The following linear equation proved to approximate very closely the average values of oxygen intake measured during the treadmill test:

$$V_{O_2} = v \times w \times (.073 + \frac{oc}{100}) \times 1.8$$

where

$V_{O_2}$ = the oxygen consumption in ml/min. (STPD)

v = the treadmill speed in meters/min.

w = the body weight in kilograms

oc = the treadmill angle in per cent

1.8 = the factor constituting the oxygen requirement in ml/min. for 1 meter-kilogram of work.

Considering the maximal oxygen consumption as the most satisfactory means of describing work capacity, the oxygen intake at the "crest load," expressed in milliliters per kilogram per minute, might be preferred as a functional criterion of physical performance capacity to either the time or the treadmill grade of the critical test minute. In table 1 an attempt is made to correlate the results demonstrated in figures 1 and 3 with a suggested rating of physical working capacity. The rating scale is based on the results from the test population, on physiologic considerations, and on observations of men at various stages of physical conditioning.

### Pulmonary Ventilation

While work efficiency estimated from the oxygen consumption proved an impractical criterion of work capacity, the efficiency of breathing appeared more closely related to "physical fitness." Figure 4 clearly demonstrates that, on the average, the physically well conditioned person moves less air at comparable work intensities. That means, because the oxygen consumption is prac-

TABLE 1. *Rating of work capacity in correlation with maximal oxygen intake or metabolic rate, and with the test duration*

| Rating of work capacity | Oxygen intake (ml/kg/min.) | Oxygen intake of a 75-kg man (ml/min.) | Multiples of resting metabolic rate | Test duration (minutes) |
|---|---|---|---|---|
| inferior | - 25 | - 1875 | - 7 | - 8 |
| very poor | 25 - 30 | 1875 - 2250 | 7 - 8 | 8 - 11 |
| poor | 30 - 35 | 2250 - 2625 | 8 - 9 | 12 - 14 |
| fair | 35 - 40 | 2625 - 3000 | 9 - 11 | 15 - 17 |
| good | 40 - 45 | 3000 - 3375 | 11 - 12 | 18 - 20 |
| very good | 45 - 50 | 3375 - 3750 | 12 - 14 | 21 - 23 |
| excellent | 50 - 55 | 3750 - 4125 | 14 - 15 | 24 - 26 |
| superior | 55 + | 4125 + | 15 + | 27 + |

tically identical, that the extraction rate of oxygen from the inspired air is greater in the more physically fit man and, in turn, the fraction of carbon dioxide in the expired air also is greater.

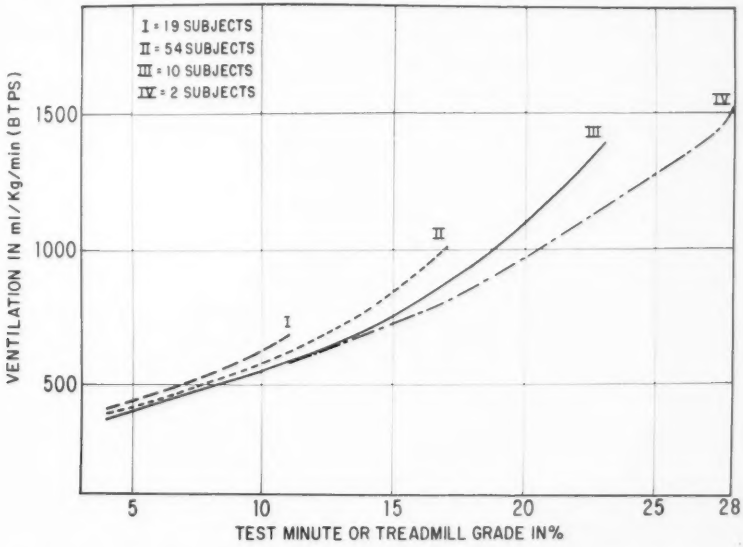


*Figure 4. Pulmonary ventilation (per unit of body weight) serves as a somewhat better indicator of work efficiency than the oxygen consumption. Greater work capacity is associated with a greater respiratory efficiency and, usually, with a greater maximal breathing capacity.*

In addition to such qualitative differences, the same figure demonstrates quantitative differences: the "maximal breathing capacity during work" attains higher values with progressing physical performance capacity.

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## GENERAL OBSERVATIONS

Factors such as age, activity, weight, and personal habits were shown to have some effect on the work capacity of the test population. It is a common belief that "aging" leads to a progressive deterioration of physical working capacity. Although the decrease of speed, elasticity, muscular strength, oxygen debt capacity, and of several other parameters of functional capabilities appear well established, it is known that some older men can be surprisingly efficient in activities such as farming or other occupational outdoor work, in hiking, climbing, skiing, and even in sports as tennis, fencing, and others which require considerable skill.

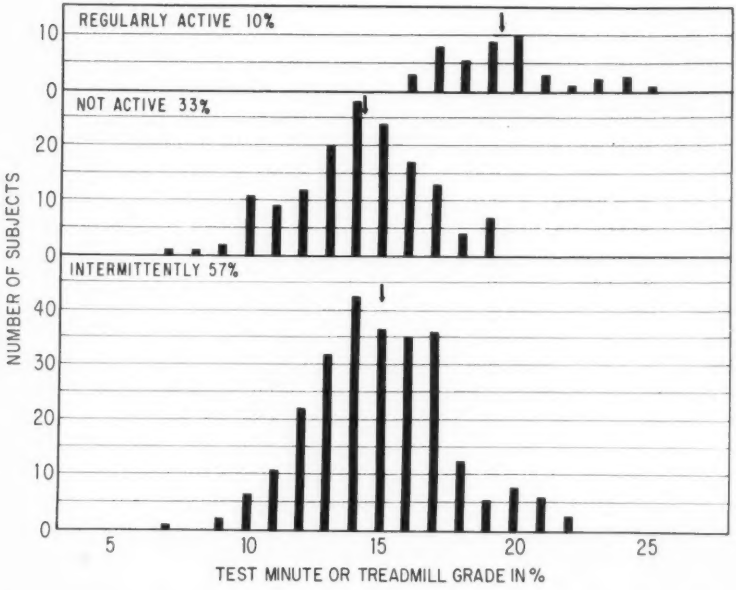


*Figure 5. Distribution of the individual test results as related to physically active or inactive living habits. Arrows indicate group averages.*

The present experimental study has demonstrated that aerobic work capacity is not inevitably affected by age, but is affected far more by living habits. On the basis of replies of 455 persons to the question regarding physical activities, 149 persons (33 per cent) had to be regarded as living a strictly sedentary life, 260 (57 per cent) engaged "intermittently" in some sort of sports or outdoors work, and only 46 (10 per cent) considered themselves as regularly active in any kind of physical exercise.

Distribution of the individual test results (fig. 5) reveals a poor average performance for the sedentary group, a poor to fair

level of work capacity for the intermittently active group, and good functional reserves for the group with regular physical activity.

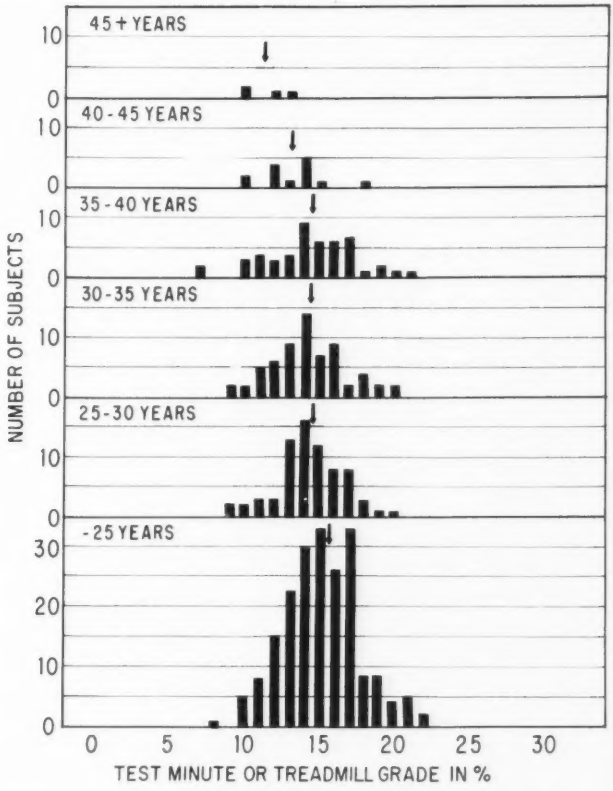


*Figure 6. Distribution of work capacity of the test population with sedentary living habits, according to various age groups.*

The results for the first two groups support the general opinion that work capacity is reduced as age advances (fig. 6), but results for the group with regular physical activity demonstrate that a high level of capacity for aerobic work can be maintained as one grows older (fig. 7). This latter group includes persons in the age range from 22 to 65 years, the average being 36 years.

The effect of weight on performance capacity was evaluated by dividing the test population into groups of normal weight, underweight, and overweight individuals. The following crude yardstick was used to make this differentiation: the weight was considered as "normal" within 90 to 100 per cent of the total body length in centimeters minus 100 centimeters. For example,

a man who measured 182 cm in height (6 ft) was considered as having a normal weight within the range of 74 to 82 kg, which is between 90 to 100 per cent of 82 (182 cm minus 100). "Underweight" or "overweight" was indicated when a man of the same height weighed less than 74 kg or more than 82 kg, respectively.

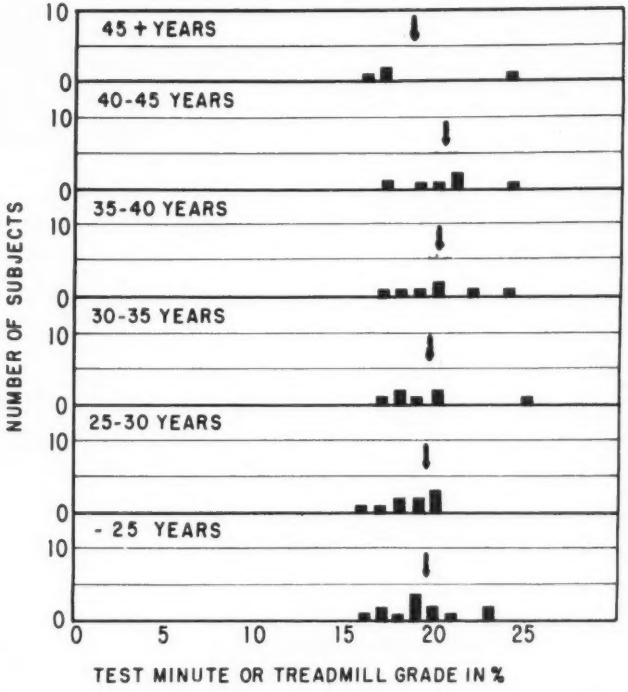


*Figure 7. Distribution of work capacity found in the group with regular physical activity.*

Figure 8 illustrates the slight handicap of the overweight type who, on the average, had a poor work capacity while the normal and underweight men were somewhat better off.

Of the 455 persons included in these observations 33 per cent fitted into the overweight group and, contrary to our expectation, 25 per cent had to be considered underweight—according to the standard used.

When the entire test population was divided into the four subgroups—officers, noncommissioned officers, airmen, and civilian personnel—slight differences in the functional reserves between the groups were detected. Civilian personnel and airmen had a slight edge with 15.6 and 15.4 minutes of average test duration, officers averaged 14.9 minutes, and noncommissioned officers

14.5 minutes (fig. 9). For these groups the average oxygen intake per kilogram of body weight was 38, 37.5, 36.7, and 36 milliliters per minute, respectively. In the officer group, there were practically no variations from second lieutenant to colonel. This find-

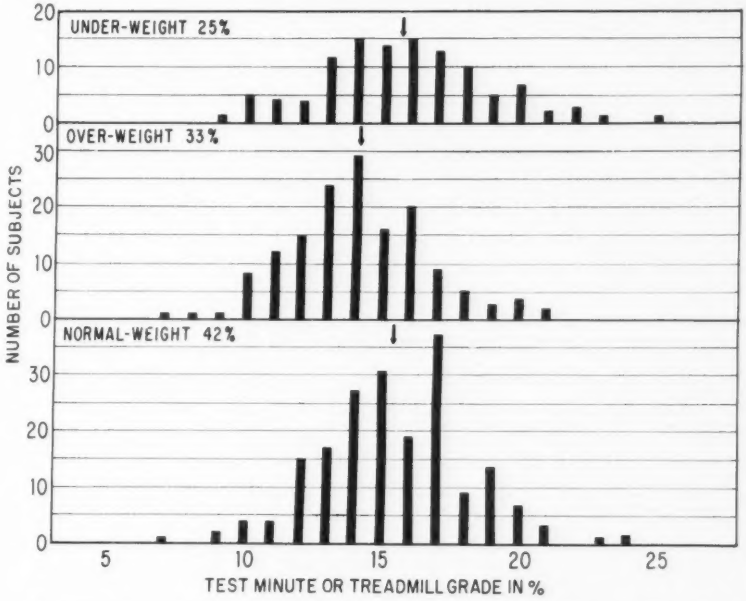


*Figure 8. Distribution of work capacity as related to the factor of weight.*

ing is probably somewhat unrealistic because in the higher ranks the experimental subjects were strictly volunteers while the lower ranking officers were mainly selected at random. Volunteers for a physical performance test are usually persons with greater interest in occasional or more regular physical activity.

An attempt was made to evaluate differences in work capacity as a consequence of smoking habits. Figure 10 shows the distribution of the test results for the smokers and nonsmokers. The nonsmokers (28 per cent of 455 persons) had an average time of 15.4 minutes, which was a slight advantage over the average test time of 14.9 minutes for the smokers. On 200 of our experimental subjects with widespread variations in age, the observation was made that up to about 30 years there was no difference in work capacity between the smokers and nonsmokers. Beyond the age of 30 years, however, the nonsmokers displayed greater functional reserves. It can be assumed that many of the nonsmokers are more conscientious as to healthful living habits, including physical exercise, and that would explain their greater capacity for work. On the other hand, it is possible

that the chronic effect of smoking affects circulatory and respiratory reserves disadvantageously.

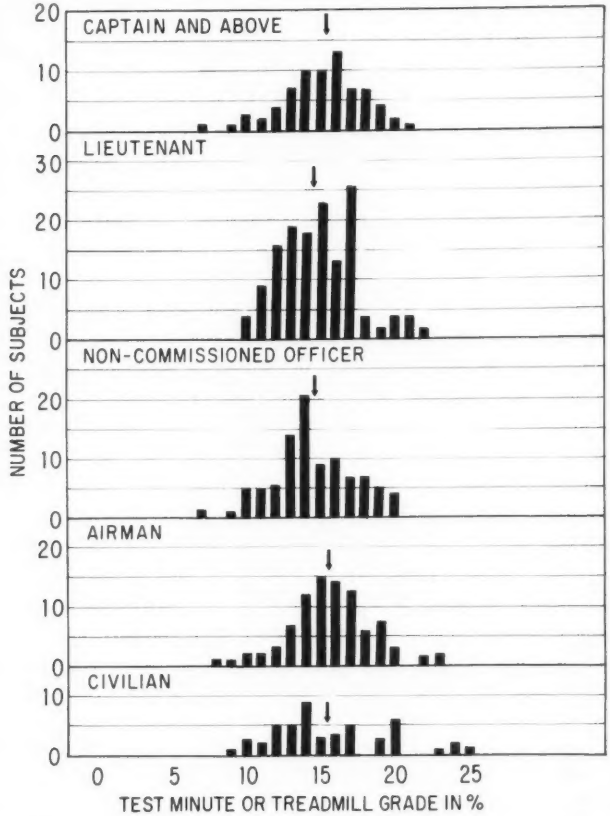


*Figure 9. Distribution of work capacity as related to military rank.*

## DISCUSSION

During the past two or three years increasing attention has been focused on the shortcomings of "physical fitness" of the American youth compared with those of other nations. It is disappointing that in several national conferences no agreement has been reached on a clear definition of "physical fitness." As a consequence, studies along this line are open to argument. Everybody delights in immediately posing the questions: Physically fit? Fit for what? In most minds, power today rests in ideas, in motives, in organization, and, above all, in technology. According to this thinking the evolution of the human race should tend toward the development of a strictly cerebral-visceral type of

man with more and more neglect of all the body parts and organs which, originally, were vital for survival. Unfortunately, a nation's place among the other nations and it's survival in the eternal struggle between them depends largely on the general vitality of the population. History has shown that the great ac-

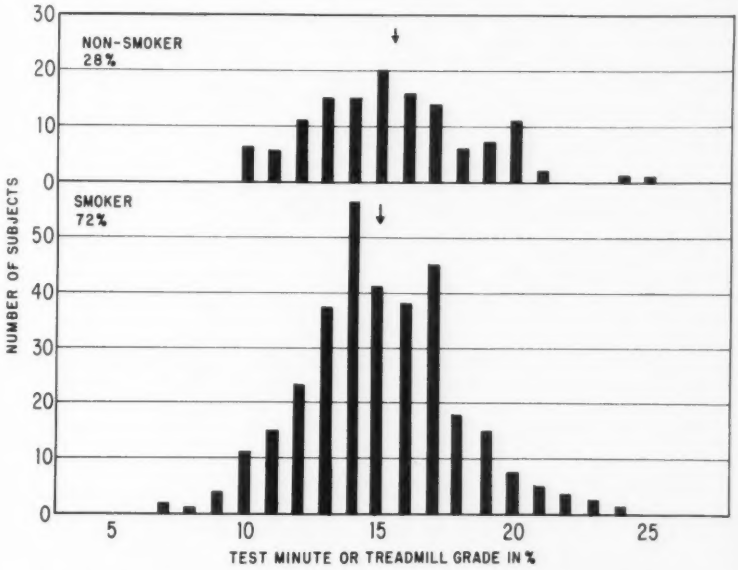


*Figure 10. Distribution of work capacity as related to the habit of smoking.*

complishments of all the ancient nations were destined to perish when a peak of civilization slowly softened the physical resistance of man against the forces of nature or against the onrush of a more vital enemy. We cannot expect this pattern to change in modern times despite all technologic advancements. Unless one does not care about destiny of future generations, conscious and sustained efforts should be made to maintain the physical capacities of man at high standards. But what are high standards or, even, what are normal standards?

The one physical capacity which most closely determines a man's ability to withstand a variety of functional demands is his capacity for work. All environmental stresses, occupational difficulties, and health hazards require proper functional and metabolic adjustments, but rarely to such an extent as strenuous physical work. It has been shown that work capacity can be appraised. The setting of "standards," therefore, is only a matter of collecting the individual performance data of a large population. The experimental work of this study was a start in that direction. Although the number of about 500 subjects is too small to allow for establishing a definite scale of work capacity, or "physical performance capacity," or "physical condition," or

"physical fitness," preliminary conclusions are experimentally justified. It became apparent from this study that 42 per cent of the test population had to be rated as being in "poor" physical condition, and only 18 per cent could be rated as having a "good" or better than good work capacity. The remaining 40 per cent constituted the population with an average performance capacity considered as "fair." This arbitrary rating might be disputable but at least it offers a quite sensitive and realistic approach for setting standards for "physical fitness." The observations made indicate: 1. The average performance capacity of persons who live a strictly sedentary life is "poor," that of those who adhere to any type of physical activity intermittently is "fair," and that of regularly active persons is "good." 2. In the group taking part in regular physical activity, work capacity apparently was not affected by advancing age within the range of 20 to 60 years. 3. In testing 131 officers on flying status (KC-97 aircraft training program) the incidences of "poor physical fitness" were 39, 51, and 58 per cent, respectively, of the test results obtained from second lieutenants, first lieutenants, captains ,and above. Results of recent experimental studies on metabolic reserves indicate that these officers would have a poor chance of survival in emergency situations requiring a higher rate of energy expenditure.

## SUMMARY

Work capacity, a sensitive and realistic measure of "physical fitness" was determined on about 500 military and civilian Air Force personnel for the purpose of collecting material for the standardization of physical performance capacity. A treadmill test permitted an evaluation of results in physical as well as in physiologic terms. On the basis of results, physiologic considerations, and observations of men at various stages of physical training, an arbitrary rating scale of work capacity is suggested. According to this pilot study 42 per cent of the test population had to be rated as "poor" and 40 per cent as "fair." Only 18 per cent could be considered as having a "good" or better physical condition. Sedentary living habits, more than aging or other factors, were apparently the main antagonists of good physical fitness.

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# APPENDICITIS IN SUBMARINERS

JOHN C. NORMAN, *Lieutenant, MC, USNR*

APPENDICITIS remains the commonest of major surgical lesions in the civilized world today. First described in 1886 by Dr. Reginald Fitz,[1] father of the late dean of Harvard Medical School, it remains today, 73 years later the cause of about five thousand deaths from perforation and peritonitis annually in the United States.[2] With the recent widely publicized extended voyages of the nuclear-powered submarines *Nautilus, Seawolf,* and *Skate,* it becomes readily apparent that tactically the limitations of such operations are becoming less and less mechanical and more and more related to human frailties.

Without doubt, no other single disease is cause for more anxiety to submariners than appendicitis.[3] A review[4] of 1,471 combat submarine patrols in World War II indicates that:

1. Pharmacists mates (hospital corpsmen of today) made the diagnosis of appendicitis on 116 war patrols in 127 instances.

2. Patients were transferred from submarines with the diagnosis of appendicitis in 34 instances.

3. In 11 instances appendicitis was the cause for submarines to leave their areas of operation, or formations, or to terminate their patrols.

4. Three appendectomies were performed on submarines by hospital corpsmen, one of whom had assisted at surgical procedures previously. The first was on the fourth patrol of the U. S. S. *Seadragon* by Pharmacist's Mate, first class, W. B. Lipes, 11 September 1942. The procedure lasted three hours and little technical information is available. The second was aboard the U. S. S. *Grayback* during its fifth war patrol by Pharmacist's Mate, first class, H. R. Roby, USNR. The procedure lasted one and a half hours. The appendix was ruptured. Sulfanilamide powder was instilled locally, and drainage effected with a cut rubber band. Ether was used as an anesthetic. The first assistant was a motor machinists mate first class. Spoons were flattened and used for retractors, long-nose pliers from the engine room were used as forceps, and a submarine escape "lung" mouthpiece was used for administering the ether. The third appendectomy was performed

From Station Hospital, U. S. Naval Submarine Base, New London, Conn. Dr. Norman is now at Columbia-Presbyterian Medical Center, 622 West 168th Street, New York, N. Y.

aboard the U. S. S. *Silversides* during its fourth war partol, on 22 December 1942, by Pharmacist's Mate, first class, T. A. Moore. The procedure, performed on the wardroom table with the submarine submerged at 100 feet, lasted four hours. One hour after completion, the submarine engaged an enemy destroyer. "The following morning the patient convalesced . . . to the tune of torpedo firing, two depth charge attacks, two 'crash dives,' and an aerial bombing which knocked the patient out of his bunk."

It remains to be emphasized, however, that there is no record of a death ascribed to appendicitis aboard a submarine during World War II.

Currently nuclear-powered submarines have a medical officer on board during their major and unusual operational cruises. Presumably an appendectomy could be undertaken with less trepidation than in the three aforementioned cases. Open drop ether (extremely hazardous in a submerged submarine) or spinal anesthesia attended by an uninitiated assistant, with the patient on the wardroom table should be avoided.

Hence, the rationale for careful scrutiny of prospective and current members of submarine crews in anticipation of such a turn of events. A careful evaluation of a man in regard to anticipating appendicitis should become routine during his attendance at submarine school, escape tank training, and nuclear power school; between cruises, and during upkeep periods. Before being sent to sea, any previous history of recurrent or isolated bouts of abdominal pain or suspected "attacks of appendicitis" should necessitate a man's being seen by the surgeon at the nearest hospital facility ashore. Flat films of the abdomen, screening for coproliths[5] or any intra-abdominal calcifications should become as much a matter of course as the routine screening chest films. The following cases illustrate this.

## CASE REPORTS

*Case 1.* On 25 August 1958, a 29-year-old lieutenant from a submarine was seen at this station hospital, with the chief complaint of pain in the right lower abdominal quadrant for the preceding 24 hours. When first seen by the author, the patient was reading a newspaper in the hospital library and was anxious to return to his submarine. He exhibited no anorexia, malaise, or constitutional symptoms. There was no history of nausea or vomiting, exotic food intake, variation in bowel habits, or genitourinary dysfunction. Physical examination revealed a well-developed, well-nourished, 29-year-old male in no acute distress. His abdomen was soft and scaphoid. Bowel sounds were normal, and there was no evidence of spasm, rebound, or referred pain. Psoas and obturator signs were negative. Rectal examination revealed no abnormal findings. Roentgenograms of the chest and flat films of the abdomen were negative. The patient's temperature was 98.8°F rectally. The white blood cell count was 6,200 per $\mu$l,

with a normal differential. The urinalysis was negative. In short, the only two reasons for suspecting abdominal mischief were tenderness over McBurney's point and the patient's history of having been admitted to the U. S. Naval Hospital, Philadelphia, Pa., seven months previously with the suspected diagnosis of appendicitis, only to be discharged after signs and symptoms regressed. The decision to operate was influenced, in the main, because of these two aforementioned reasons along with a third—the fact that he was a member of the ship's company of an operating submarine. One hour later an acutely inflamed, indurated, fibrin-coated appendix, three to four times normal diameter was removed!

*Case 2.* On 25 June 1958, a submarine radioed the base communications center at the New London Submarine Base that it was cancelling its operations off the Atlantic coastline and returning at flank speed with a patient diagnosed by the hospital corpsman aboard as having acute appendicitis. The patient arrived at this station hospital at 0315 on 26 June. He was a well-developed, well-nourished 21-year-old seaman who volunteered immediately that his symptoms of minimal nausea and vomiting had subsided completely and the right lower quadrant pain had improved "50 per cent." The abdomen was soft and scaphoid. Bowel sounds were normal. There was no evidence of spasm, rigidity, rebound, or referred pain. The rectal examination was negative (though previously reported as minimally tender high on the right when examined by the hospital corpsman aboard the submarine.) Psoas and obturator signs were negative. Minimal point tenderness over McBurney's area persisted. The patient was afebrile rectally. The white blood cells numbered 8,600 per $\mu$l. The urinalysis was negative. Because of apparently subsiding symptoms, expectant treatment was elected. The following day no abdominal symptoms were present. In an effort to anticipate and prevent the recurrence of a similar episode while at sea, however, elective interval appendectomy was scheduled for the following week and the removal of a normal appendix envisioned. On 2 July 1958, seven days later, a persistently acutely inflamed retrocecal appendix was removed!

## COMMENTS

Recurrent episodes of "appendicitis" diagnosed in retrospect after or during appendectomy are a common occurrence. Evidence of previous appendiceal inflammation are seen repeatedly by the abdominal surgeon who performs prophylactic appendectomy during the course of cholecystectomy, hysterectomy, or other elective intra-abdominal procedures. Cases of perforation, proceeding to localization and even to autoamputation at the appendiceal base with resolution of the process and recovery with neither operation nor hospitalization have been reported. Determining the outcome of any isolated episode in regard to the progression to eventual rupture, spreading peritonitis and its attendant morbidity and mortality, remains a matter of pure conjecture.

An aggressive approach among submariners to all suspected cases of appendicitis seems justifiable. Nonetheless, it seems somewhat extreme to advocate, as did some of the medical facilities supporting the crews of the German "Wolfpack" Unterseebooten during World War II, appendectomy for all crew members regardless of presence or absence of symptomatology. However, it seems reasonable and justifiable to state that: 1. Appendicitis is the commonest medical emergency requiring surgical intervention among submarine crews. 2. Appendicitis can be (and has been) the cause of cancelling a combat submarine patrol, disengaging an attack, or leaving the area of routine peacetime operations. 3. The wardroom table of a submerged submarine with its attendant disadvantages is by no means the most opportune place for a medical officer, much less a hospital corpsman, to undertake an appendectomy. 4. The signs and symptoms of appendicitis are protean, often bizarre, and occasionally minimal in presentation—belying underlying active inflammation. 5. Previous history of a documented or suspected "attack," the presence of an asymptomatic fecalith on screening flat film, or point tenderness which persists in the absence of other findings in a submariner warrants uncommon scrutiny and close surveillance.

ACKNOWLEDGEMENT. The author wishes to express appreciation to Captain Walter Welham, MC, USN, Medical Officer, Submarine Force, U. S. Atlantic Fleet, for his assistance.

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## HOW TO AVOID CARDIAC ARREST

I would make a plea to all exponents of the art of anesthesiology that they be diligent and conscientious in preventing the tragedy of cardiac arrest. The reputation of this profession and the lives of the patients are at stake. Avoid hypoventilation with its vicious offspring, hypoxia and hypercapnia. Protect the patient against noxious reflexes by proper and adequate premedication. Mistrust the halogens. One agent well understood and administered still is more valuable than a polypharmaceutical barrage, of which the evaluation is difficult. Keep it simple, be watchful, be careful, be safe.—Kenneth C. McCarthy: The Problem of Cardiac Arrest. *The Journal of the American Medical Association,* December 20, 1958.

# STARCH BLOCK ELECTROPHORESIS OF HEMOGLOBIN

HOWARD A. PEARSON, *Lieutenant, MC, USN*
WILLIAM McFARLAND, *Commander, MC, USN*

THE technic of zone electrophoresis of proteins using a block of sedimented starch grains as a supporting medium was described seven years ago[1] and first used for hemoglobins in 1955 by Kunkel and Wallenius.[2] However, it is currently available in relatively few medical centers. Many physicians are not familiar with this test and its great value in the diagnosis of certain hematologic conditions, especially thalassemia trait. It therefore is considered worthwhile to describe this technic and to briefly outline its advantages and limitations.

The discovery by Pauling and his associates[3] of sickle-cell hemoglobin by means of its difference in electrophoretic mobility from normal hemoglobin gave impetus to a large series of investigations. Other abnormal hemoglobins were rapidly discovered. Diagnosis of the clinical syndromes associated with the various abnormal hemoglobins was markedly facilitated by the development of filter paper electrophoresis, a rapid and inexpensive procedure. For most clinical situations, it is entirely satisfactory. However, this method of electrophoresis has certain inherent disadvantages, most important of which is lack of sensitivity in separation of minor components from hemoglobin mixtures. Thus Motulsky, Paul, and Durum[4] demonstrated that in concentrations of less than 15 per cent, types S or C hemoglobin could not be regularly detected in artificial mixtures. Zuelzer, Neel, and Robinson[5] showed that under certain conditions even larger proportions of abnormal hemoglobins might escape detection. The recently discovered Lepore hemoglobin, which accounts for about 10 per cent of the hemoglobin of persons with Lepore trait cannot be detected by paper electrophoresis.[6,7]

Kunkel and associates,[2,8] using starch block electrophoresis, observed a small fraction of hemoglobin distinct from the hemoglobin A of all normal persons. They called this minor component hemoglobin $A_2$ (Hb $A_2$), and showed that in normal persons it

From U. S. Naval Hospital, Bethesda, Md.

accounted for between 1.5 and 3.1 per cent of the total hemoglobin. In persons with thalassemia trait, however, Hb $A_2$ was increased to values above 3.2 per cent. The nearly invariable elevation of Hb $A_2$ in the thalassemia trait has for the first time provided the clinician with a relatively specific test for this condition. Because Hb $A_2$ cannot be detected regularly by filter paper electrophoresis, it is in the detection and quantitation of this and other minor hemoglobin components that starch block electrophoresis has its greatest clinical application.

## APPARATUS AND TECHNIC

The apparatus and method used by us is that described by Gerald and Diamond[9] with minor modifications.

*Apparatus.* The apparatus (fig. 1) is constructed from heavy plastic. The chief components are two rectangular containers which serve as buffer vessels. A central partition divides each buffer vessel length-

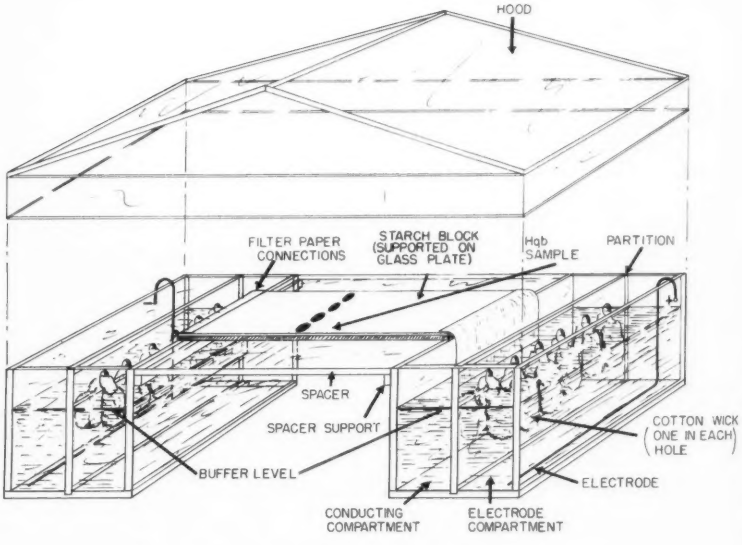


*Figure 1. Starch block electrophoretic apparatus.*

wise into electrode and conducting compartments. The partition is solid except for five holes above the surface level of the buffer. Cotton wicks through these holes connect the buffer in each compartment. The buffer vessels are separated by two plastic spacers, and a piece of glass holding the starch block is supported between the medial rims of the buffer vessels and spacers converting the whole apparatus into a closed unit. During operation the entire unit is placed in a refrigerator at 8°C.

*Power supply.* A power supply which will provide currents of 40 to 80 milliamperes at 250 to 400 volts is essential. Although a constant-voltage apparatus is satisfactory, a constant-current power supply is ideal. Simple electrodes are made of stainless steel.

*Preparation of hemolysate.* The blood sample is collected with any standard anticoagulant. The red cells are washed three times with cool normal saline and hemolyzed with twice their volume of distilled water and one half their volume of toluene. After standing for about one hour in the refrigerator, the mixture is centrifuged at low speeds. An amorphous layer of stroma and toluene is aspirated from the surface, and the hemolysate is then subjected to high-speed centrifugation at 25,000 r. p. m. for 30 minutes in a Spinco ultracentrifuge. An absolutely clear solution of oxyhemoglobin with a concentration of about 8 grams per 100 ml is obtained. In lieu of ultracentrifugation, other laboratories have clarified the hemolysate by filtration through an asbestos pad or a bed of asbestos shreds. It is extremely important that the hemolysate be free of stroma to avoid trailing and obscuring of the final pattern.

*Buffer.* Any standard buffer for protein electrophoresis may be used. For work with hemoglobins, a veronal (barbital) buffer of pH 8.6 and ionic strength 0.05 is most useful.

*Preparation of the starch block.* A glass plate, measuring 6½ by 12 inches, is converted into a mold by rimming the long edges with strips of masking tape. The short edges are dammed with several thicknesses of filter paper. Two hundred grams of analytic potato starch are washed by passing 1.5 liters of buffer solution through the starch in a large Buchner funnel. The starch is allowed to sediment for one hour in an equal amount of buffer, and the excess buffer and unsettled starch are removed. The starch is then stirred into a mixture which pours easily into the above-described mold. After about 30 minutes the edges of the mold may be removed, leaving a solid block of starch 5 mm thick. The surface of this is smooth and flat.

*Application of hemolysate to the starch block.* Just before starting the run, 0.3 ml of hemolysate is converted to cyanmethemoglobin by adding a drop of 5 per cent potassium ferricyanide and a drop of 2 per cent acidified sodium cyanide. Four deep slits are made in a row in the center of the starch block with the tip of a spatula. Four specimens may be electrophoresed during each run. A larger block, measuring 10 by 12 inches, permits simultaneous running of seven samples. Cyanmethemoglobin solution, 0.1 ml, is evenly inserted into each slit with a tuberculin syringe and No. 23 needle. The slits are then closed by gentle pressure with a spatula tip.

*Starting the run.* The completed starch block is placed in position on the inside rims of the filled buffer vessels in the refrigerator. The block is connected to the conducting compartment buffer with three sheets of Whatman No. 3 filter paper. The electrodes are placed in

their compartments and connected by leads to the power supply. The hood is placed over the apparatus, and the power is turned on. The duration of the run is 16 to 24 hours at 48 ma. of current.

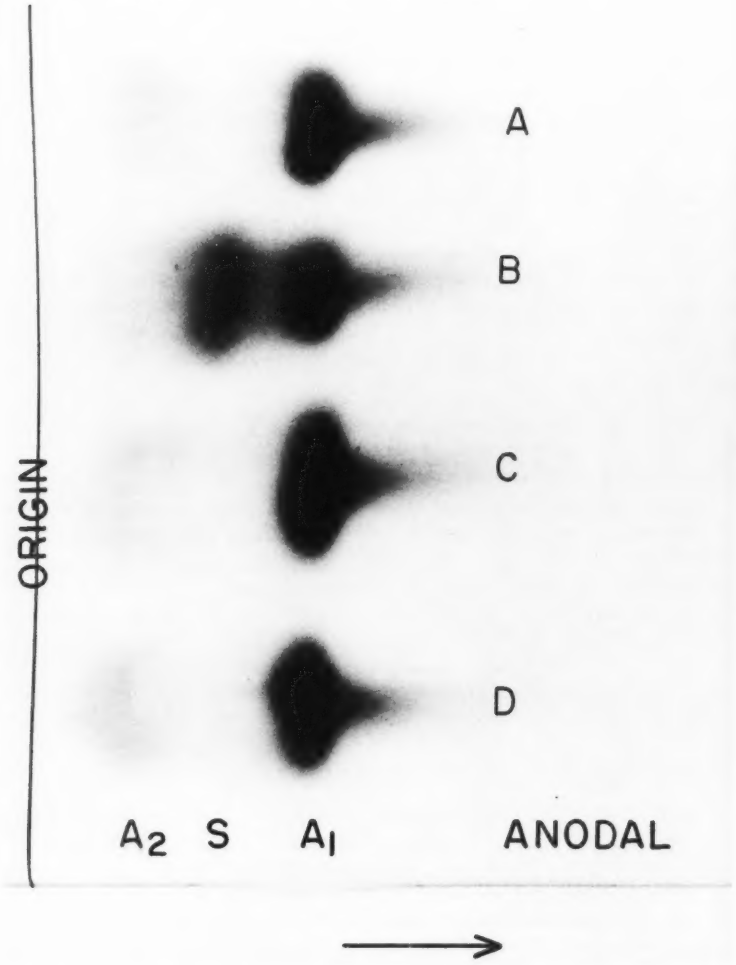


*Figure 2. Starch block electrophoresis. Barbital buffer, pH 8.6, ionic strength 0.05. Current, 48 ma; duration of run, 22 hours. (A) Normal, $A_2$ fraction of 2.3 per cent. (B) Sickle trait. (C) Iron deficiency anemia, $A_2$ fraction of 1.5 per cent. (D) Thalassemia trait, $A_2$ fraction of 4.1 per cent.*

*Quantitation of the hemoglobin fractions.* When the run is completed, the block is removed and blotted dry. If a permanent visual record is wanted, a photograph may be taken (figs. 2 through 4). The segments

of the block bearing the various hemoglobin fractions are cut from the block and transferred to fine sintered glass funnels. The hemoglobins may then be recovered by elution with distilled water and a suction apparatus. The $A_2$ fraction is collected in 10 ml and the $A_1$

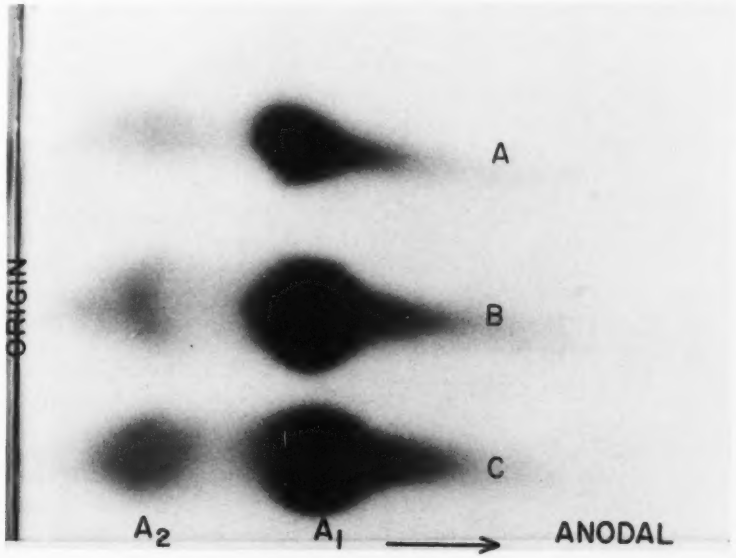


*Figure 3. Starch block electrophoresis. (A) Normal, $A_2$ fraction of 2.4 per cent. (B) Thalassemia trait (case 2), $A_2$ fraction of 4.3 per cent. (C) Thalassemia trait, $A_2$ fraction of 5.7 per cent.*

fraction in 100 ml of eluate. The optical density of each fraction is measured in a Beckman DU spectrophotometer at a wavelength of 415 millimicrons. The per cent of $A_2$ may then be calculated:

$$\% A_2 = \frac{\text{O. D. of } A_2 \text{ fraction}}{(\text{O. D. of } A_1 \text{ fraction} \times 10) + \text{O. D. of } A_2 \text{ fraction}}$$

Other hemoglobin components such as S, C, or F may be quantitated in a similar manner.

## CASE REPORTS

To illustrate the clinical value of starch block electrophoresis, our experiences with several patients are briefly described.

*Case 1.* A 36-year-old woman of Latin descent was admitted to this hospital for evaluation of anemia. She was recovering from severe paralytic poliomyelitis. Three months previously a moderate anemia had been observed. Ferrous sulfate by mouth had been prescribed without rise in the hemoglobin level. Examination of the patient's blood revealed a hemoglobin of 10.0 grams per 100 ml and stained smear showed hypochromia with many microcytes, poikilocytes, and

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occasional target cells. Because of the erythrocyte morphology and the patient's nationality, thalassemia trait was considered in

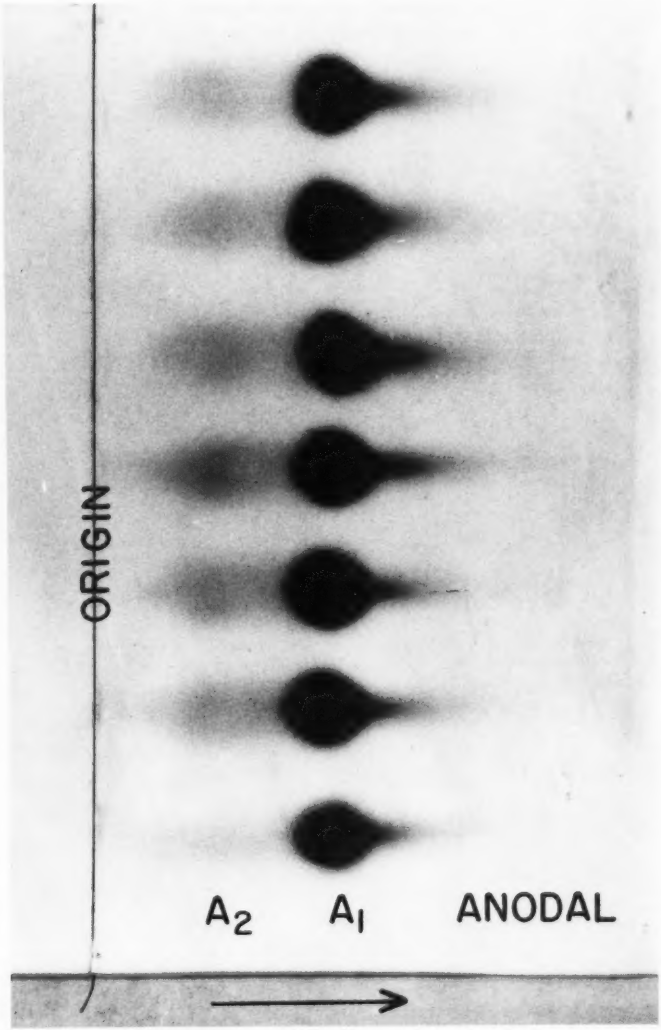


*Figure 4. Starch block electrophoresis. This is a large block measuring 10 by 12 inches, permitting the simultaneous analysis of seven specimens. All of the hemoglobin $A_2$ fractions are normal, varying between 1.8 and 3.0 per cent.*

the differential diagnosis. Starch block electrophoresis of her hemoglobin, however, revealed an $A_2$ fraction of only 1.8 per cent,

thus excluding thalassemia trait. The patient was treated with iron parenterally with prompt rise in the hemoglobin level.

*Case 2.* A 34-year-old woman of Scotch-Irish ancestry was referred to this hospital for evaluation of chronic anemia. Anemia had been observed several times in the past and the patient had been treated with iron on each occasion. Hemoglobin was 10.1 grams per 100 ml. Blood smear revealed moderate hypochromia and microcytosis with occasional target and oval cells. Starch block electrophoresis of the hemoglobin revealed an $A_2$ fraction of 4.3 per cent (fig. 3). Subsequent investigations, including ferrokinetic and osmotic fragility studies, also were consistent with the diagnosis of thalassemia trait.

*Case 3.* A three-month-old child of Italian descent was admitted to another naval hospital for investigation of anemia and jaundice. Physical examination revealed enlargement of the liver and spleen. Laboratory examination disclosed a moderate hypochromic microcytic anemia with target cells and occasional nucleated red cells. Bilirubinemia also was recorded. Thalassemia major was considered a possible diagnosis. Specimens of the parents' blood were sent to this laboratory by regular mail. Starch block electrophoresis revealed normal Hb $A_2$ fractions of 2.5 and 2.8 per cent. Thalassemia major is a homozygous condition. Exclusion of thalassemia trait in the parents ruled out the diagnosis of thalassemia major in the child. Further studies established the diagnosis of neonatal hepatitis in this child.

## DISCUSSION

Thalassemia trait is a mild familial anemia characterized by red cell hypochromia, microcytosis, leptocytosis, and decreased osmotic fragility. When seen in a person of Italian or Greek ancestry, these features almost certainly indicate the diagnosis of thalassemia trait. The red blood cell changes listed above, however, are frequently observed in other syndromes and cannot be considered diagnostic or specific for thalassemia trait. In addition, typical thalassemia is being recognized in persons with no demonstrable Mediterranean background—as in case 2.

The elevated hemoglobin $A_2$ level demonstrated by starch block electrophoresis has provided the most objective and specific test for thalassemia trait available to date. Extensive investigations, both in this country and in Italy, have documented the almost invariable elevation of Hb $A_2$ in thalassemia trait.[8-11] In our experience also, levels of Hb $A_2$ in excess of 3.2 per cent have been seen only in thalassemia trait. Clinically, this procedure has been valuable in quickly and definitively differentiating thalassemia trait from other microcytic, hypochromic anemias.

In our opinion, the major disadvantage of starch block electrophoresis is that it is relatively too expensive and difficult to

standardize to become a routine procedure in most laboratories. In addition, the sensitivity of the technic is not required for most clinical diagnostic problems. Fortunately, hemoglobin $A_2$ and most other hemoglobins are stable. This permits the mailing of blood samples to a laboratory where starch block electrophoresis is being routinely performed.

## SUMMARY

The technic of starch block electrophoresis of hemoglobins is described. The particular value of this technic lies in its sensitivity in detecting minor hemoglobin components. One such minor component is hemoglobin $A_2$. This is a fraction seen in the blood of normal persons, accounting for 1.5 to 3.1 per cent of the total hemoglobin. However, in persons with thalassemia trait, $A_2$ is elevated above the normal values, providing an objective and relatively specific laboratory test for the diagnosis of this condition. It is suggested that starch block electrophoresis of hemoglobin is an indicated test of the evaluation of any iron refractory, hypochromic anemia.

ACKNOWLEDGMENT: The authors wish to express their appreciation to Drs. Park Gerald and Louis K. Diamond, in whose laboratory the technic was learned. Captain E. R. King, MC, USN, Head of the Radioisotope Laboratory, U. S. Naval Hospital, Bethesda, Md., gave his advice and encouragement to the project.

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# SPINAL CORD INJURIES IN WORLD WAR II

## II. Operative Findings and Results in 201 Patients

WOLFGANG W. KLEMPERER, *M. D.*

WHILE the statistics (table 6) bring out a certain latitude in the choice of anesthesia in the various spinal cord injuries, two rules were observed. These were to avoid spinal anesthesia and, where a general anesthetic was used, to intubate those patients in whom respiratory embarrassment was a possibility. The likely diffusion of the anesthetic agent into the tissues, resulting in inefficient or unsatisfactory anesthesia, the danger of introducing or propagating infection in a potentially contaminated field into deeper muscle layers or bony structures, and the limitation of operative time were some of the reasons why spinal anesthesia was not employed in closed or compound spinal cord injuries. Also, it was feared that an anesthetic agent might add further histologic change to an already damaged spinal cord. Table 6 brings out the preference for local anesthetic in cervical levels. In cervical injuries that are frequently critical because of impaired innervation of respiratory muscles, any additional pulmonary burden such as endotracheal moisture or atelectasis, that are sometimes seen following endotracheal intubation, may decide the patient's survival. Because so many thoracic spinal cord injuries were complete lesions, impairing respiratory excursions, and since another group had serious chest wounds, local anesthesia was used more often than in lumbar lesions. With a local anesthetic, patients always could bring up secretions and were able to breathe deeply at all times.

### OPERATIVE FINDINGS

All degrees of destruction of the spinal column and spinal cord were noted. Usually the cord damage resulted from bony fragments of fractured laminae, driven ahead of the foreign body into dura and spinal cord. The foreign body itself was usually not directly responsible for the trauma inflicted to those two structures. The time interval between injury and operation was the deciding factor in the appearance of the cord injury. In the early phase contusions and areas of softening of the cord could

Dr. Klemperer is at 1121 Medical Dental Building, Seattle, Wash.

be seen only with difficulty; the consistency of the cord was easier to determine and a softened cord segment could be discovered by very gentle palpation with a finger tip or rounded instrument. Later on these lesions became contracted scars with dense adhesions between spinal cord, arachnoid and dura and many new vessels between these structures. In a few cases damaged or cut spinal roots were seen to have formed neuromas.

TABLE 6. *Types of anesthetics for spinal cord injuries*

| Level of spinal cord injury | Anesthetic | | Number of patients |
|---|---|---|---|
| Cervical | Local | | 32 |
| | General | | 12 |
| | Pentothal and local | 7 | |
| | Ether | 5 | |
| Thoracic | Local | | 30 |
| | General | | 47 |
| | Pentothal and local | 8 | |
| | Pentothal | 5 | |
| | Ether | 34 | |
| Lumbar | Local | | 5 |
| | General | | 39 |
| | Pentothal and local | 11 | |
| | Pentothal | 7 | |
| | Ether | 18 | |
| | Ether and pentothal | 3 | |
| Sacral | Local | | 1 |
| | Spinal | | 1 |
| | General | | 3 |
| | Pentothal | 1 | |
| | Ether | 2 | |
| Unknown | | | 11 |

The difficulty of determining the expected clinical picture from the gross inspection of the damaged cord is well known. Often, it is possible only to confirm the exact level and location of the injury, or to state which side of the spinal cord was damaged. A Brown-Séquard syndrome or a close variation of it was seen quite often. Table 7 was arranged according to the basic operative findings and the effect on the function of the spinal cord during the first three months after injury. In the first group of table 7, in which the vertebra was fractured but spinal dura mater and cord remained anatomically intact, the high percentage of incomplete lesions is not surprising. However, the velocity and penetrative power make a striking difference. Foreign bodies that perforated the entire body caused complete lesions in 60 per cent of the cases; in the other two groups combined

only 14 per cent were complete spinal cord injuries. In the second group, in which visible damage was done to vertebra and dura, each group was actually too small to draw any definite conclusions. It appears, however, there is no appreciable difference

TABLE 7. *Operative and spinal cord findings in 163 cases three months after wounding*

| Position of foreign body | 67 cases with vertebra fractured; spinal cord and dura intact | | 36 cases with vertebra fractured; dura perforated | | 60 cases | |
|---|---|---|---|---|---|---|
| | Complete spinal cord lesions | Incomplete spinal cord lesions | Complete spinal cord lesions | Incomplete spinal cord lesions | Complete spinal cord lesions | Incomplete spinal cord lesions |
| Outside spinal canal | 5 | 27 | | | | |
| Spinal cord intact* | | | 4 | 2 | | |
| Spinal cord damaged | | | 6 | 3 | | |
| Inside spinal canal | 2 | 16 | | | | |
| Spinal cord intact* | | | 3 | 9 | | |
| Spinal cord damaged | | | 5 | 4 | | |
| Inside spinal cord | | | | | 17 | 3 |
| Perforated spinal cord | | | | | 28 | 0 |
| Transected spinal cord | | | | | 12 | 0 |
| Perforated patient's body | 10 | 7 | | | | |

* - To gross inspection.

whether the foreign body ended up outside or in the spinal canal. In the former the incidence of complete lesions is twice as common. Why the reverse holds true in the latter group of spinal cord injuries where the foreign body was arrested in the canal, leaving the cord grossly intact, is not clear. In the final group of table 7, where the foreign body ended up in the cord, perforated or transected it, that any spinal cord injury case should escape permanent, complete damage is surprising. Yet, this was noted in three cases caused by small foreign bodies. It must be pointed out that this table (table 7) represents findings during the first three months after wounding.

## INOPERABLE CASES

Of the 201 cases in this series, 22 received no operative therapy, 155 had laminectomies, 20 had debridements, 9 had Crutchfield tongs inserted (fig. 15) and in 5 cases more than one procedure was done or the laminectomy was repeated. There were various reasons for omission of operative intervention. The most common one was that the patients were simply too gravely wounded and ill, 3 cases, or were dying from shock, aspiration pneumonia, severe compound craniocerebral injury or peritonitis before operation could be considered, 5 cases.

There were another eight cases where the associated injuries and their operative procedures were too extensive to expose the patient to any further therapy. In five of these it is possible that operative procedures were done at a later date but no records are available to that effect. In three cases the initial prominence of the spinal cord signs subsided to leave

*Figure 15. Incomplete spinal cord injury at $C_5$. Use of Crutchfield tongs in tent hospital with traction rope tied to sandbag over wheel attached to tent pole.*

root signs that were not thought to be in need of operative treatment. In three cases, evacuated for strategic reasons, operative procedures may have been carried out, but again no records are available. In one case the wounds were too contaminated to allow operative procedure near or through them; later on the patient improved enough to be sent directly home. In two closed injuries, an initially demonstrated block in one patient subsided, consequently an operative procedure was unnecessary and, in the other case, already scheduled for operation, sudden death occurred from pulmonary embolus.

## POSTOPERATIVE COMPLICATIONS

Infection was the most common postoperative complication and it occurred in 23 cases. This led to fatal meningitis in three cases and in the other 20 cases the infection subsided with appropriate therapy. Most common causes of infection were bone fragments (5 cases) or foreign bodies (3 cases) left in place. Their removal in a secondary operative procedure was necessary before the infection was controlled. Contamination from an infected mediastinal, peritoneal or retroperitoneal space communicating with the spinal canal occurred in four cases. In two in-

stances muscle tissue was used to control severe hemorrhage from torn epidural veins and formed the primary site of infection; removal of this tissue was necessary to arrest the infection. In one case a very large foreign body, with grossly evident bits of clothing, had been removed in the initial laminectomy but had so contaminated the entire area as to cause postoperative infections in spite of repeated washings and postoperative administration of sulfanilamide drugs. In one case a time interval of 144 hours between wounding and operation was thought to be responsible for excessive contamination during the procedure and thereby thought to cause the postoperative infection. In the remaining two cases no specific cause of infection was obvious. Osteomyelitis occurred only twice; it was diagnosed 24 and 46 days after wounding; both patients finally died, their spinal columns having communicated with an infected and purulent mediastinal and peritoneal process.

In the early postoperative stages pain syndromes were uncommon; they occurred in the form of nerve root pain in only four cases. An ascending myelitis, a dangerous complication, was seen in five patients, leading to death in two patients as their initial sensory level was $C_5$. Myelitis usually ascends two segments and was verified at autopsy to consist of softening of two segments up and down beyond the initial site of trauma. In the other three cases myelitis was evident merely from a rising sensory level in the thoracic dermatomes and loss of the next two intercostal muscles on the right and left sides. Bullets and shell fragments were equally responsible. The reverse, a descending sensory level, was found in a complete $C_6$ injury with marked respiratory muscle weakness that improved in a matter of hours following laminectomy at site of trauma with recession of the initial sensory level. In three cases function was definitely lost after initial improvement in the first two weeks. All three cases were complete thoracic injuries with a certain amount of function of the lower extremities that consequently was lost. In one, a re-exploration showed extensive adhesive arachnoiditis involving all exposed spinal cord segments. Other spinal cord segments not uncovered during operation, probably were involved. No improvement occurred after the second procedure.

Almost as serious a postoperative complication, and one which certainly is avoidable, was a severe depression, apathy or total disinterest observed in three patients. All of these were severely emaciated and had, in addition to complete lesions, extensive complicating injuries. They refused to eat and had simply "given up." In each patient improved morale and a fresh approach by personnel in another medical installation worked amazing changes. This factor of morale has been stressed by everyone who has had any contact with spinal cord injuries. Its impor-

tance for eventual rehabilitation cannot be underestimated. Good morale especially must prevail as long as the patient requires medical help or assistance. Interestingly enough, the only instance of a distinct emotional difficulty, in the form of an anxiety state or hysteria, was observed in a patient with an almost completely recovered, incomplete spinal cord injury from a bullet wound at $Th_4$, complicated by a hemathorax. In the light of the seriousness of a spinal cord injury it is surprising that this reaction was not more common. It is indicative of the high morale in the hospitals, of the patients and of the personnel concerned and charged with their care.

## CARE OF THE BLADDER

A survey of the care of the bladder shows that, out of 112 complete spinal cord injuries, 78 patients were kept on urethral drainage with indwelling catheters and 34 had a cystotomy, which was done usually in the first three weeks. Often enough the decision to do a cystotomy was the result of a policy rather than dictated by the needs of the individual patient. In other instances insufficient personnel available in a particular medical installation necessitated this procedure. Cystotomies were performed on 12 patients during the first 5 days; on 4 patients between the 6th and 10th day; on 7 patients between the 11th and 15th day; on 7 patients between the 16th and 20th day and on 4 patients after the 20th day. No binding rules should be laid down in this respect.

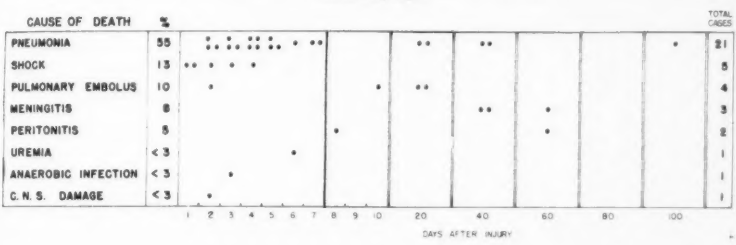
There is no question that urethral drainage, while readily available, requires more constant care and attention than does a cystotomy. But cystotomies may, in turn, lead to serious neglect, as they did in three patients of this group. Here the abdominal wounds and bladders were grossly infected with ulcerations around encrusted catheters. Operative procedure was required to replace the catheters with fresh ones. As a consequence of the operation the patients had greatly contracted bladders and a diminution of bladder volume to below 100 ml or less. Therefore, thought should be given and the directness and ease of drainage and irrigation in a cystotomy should be weighed against the additional operative trauma and the other dangers mentioned earlier. In three cases perineal urethrotomies were done. The operations proved to be most impractical and harmful as constant leakage occurred around the catheter, keeping the patient's bed wet and causing new or enlarged old bed sores. Furthermore, these perineal fistulas that were close to the rectum invariably became infected and were most reluctant to close after suprapubic cystotomies were carried out later. In incomplete lesions, cystotomies were done less readily, only six operations were performed. There were 24 patients with incomplete spinal cord injuries on urethral drainage and the remaining 59 patients had normal sphincter function from the

beginning. Forty of the 59 patients overcame an early difficulty in the first two weeks.

## DEATHS

Table 8 shows the causes of death and the time intervals from injury to death. Over half the fatalities occurred in the first week from aspiration pneumonia in complete thoracic or cervical lesions. Interestingly enough, of these 21 pneumonia cases only 4 had perforating chest wounds. In looking back, it was the author's impression that combined chest and spinal cord cases had a higher fatality rate. It speaks for the vigilance

*TABLE 8. Time intervals in days from injury to death in 38 cases of spinal cord injury.*


CAUSE OF DEATH
%
TOTAL CASES
PNEUMONIA 55 21
SHOCK 13 5
PULMONARY EMBOLUS 10 4
MENINGITIS 8 3
PERITONITIS 5 2
UREMIA < 3 1
ANAEROBIC INFECTION < 3 1
C. N. S. DAMAGE < 3 1
1 2 3 4 5 6 7 8 9 10 20 40 60 80 100
DAYS AFTER INJURY

and care of the thoracic surgeons who worked closely with the neurosurgeons that such a low mortality rate resulted in cases combining these injuries. (The total number of spinal cord injuries with chest perforations was 48.) The five cases that died of shock had severe perforating chest injuries, abdominal perforations (one case) or both, and death occurred in the first four days. None of these cases ever reached a status that would permit a laminectomy.

In four cases death was due to a pulmonary embolus. In two cases this was the result of a cast applied to facilitate transportation. These casts were complete body casts and not bivalved. Both patients arrived from 12 to 36 hours after application of this cast with markedly edematous legs. One died during the actual removal of the cast and the other became dyspneic and cyanotic almost immediately after its removal and died 36 hours later. In the other two patients the emboli were due to severe trauma to the lung in one case and a damaged subclavian vein with thrombus formation at the site of the trauma in the other. Obviously, since the first two cases with emboli formation from improper body casts occurred early in the war, the use of body casts was discouraged and no further pulmonary emboli from that source were seen thereafter. Some patients in need of immobilization, because of marked instability of the spinal column and fear of increase in the spinal deformity with further damage to the spinal cord, were placed in well-padded plaster shells.

These shells served a useful purpose not only during transportation but also helped the nursing staff to lift and turn the patient; they were well tolerated by the paraplegic patient and quite popular until the advent of the Stryker frame. The one

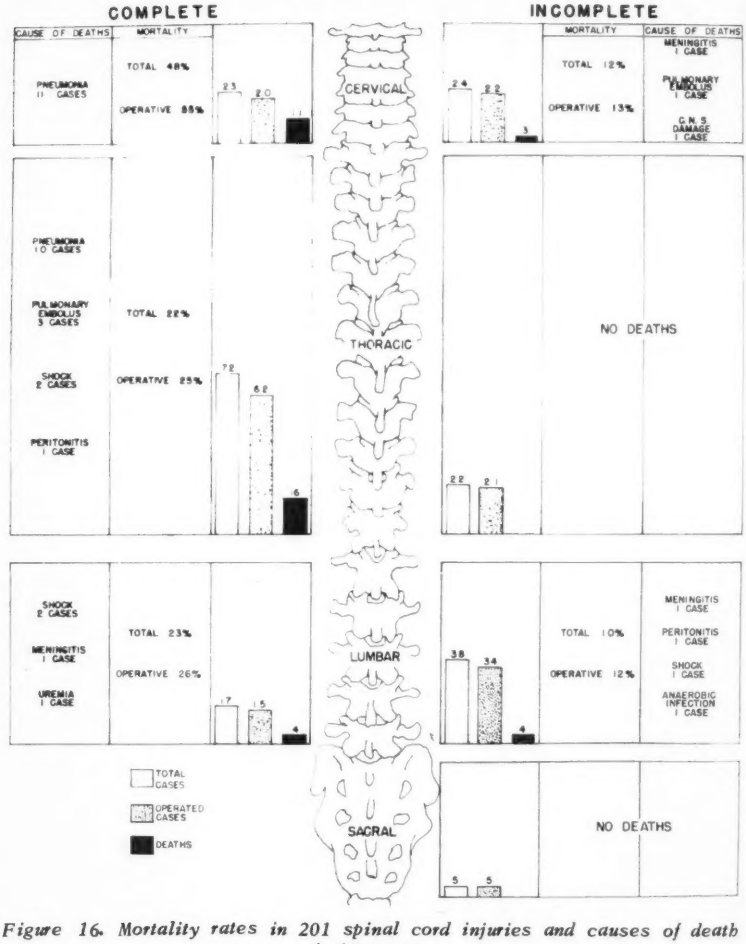



*Figure 16. Mortality rates in 201 spinal cord injuries and causes of death in 38 cases.*

case labeled "death due to CNS damage" occurred in a severe perforating wound of skull and brain. One death due to uremia occurred in a case not only with severe kidney laceration requiring nephrectomy, but also with severe perforating wounds of chest and abdomen.

Figure 16 brings out the high operative mortality rates in complete spinal cord injuries (over 55 per cent) whereas other areas

had mortality rates up to 26 per cent. Counting all types of operative procedures, namely, laminectomies, debridements and insertion of Crutchfield tongs, one obtains an over-all mortality rate of 21 per cent. Separating from this group the 155 lamin-

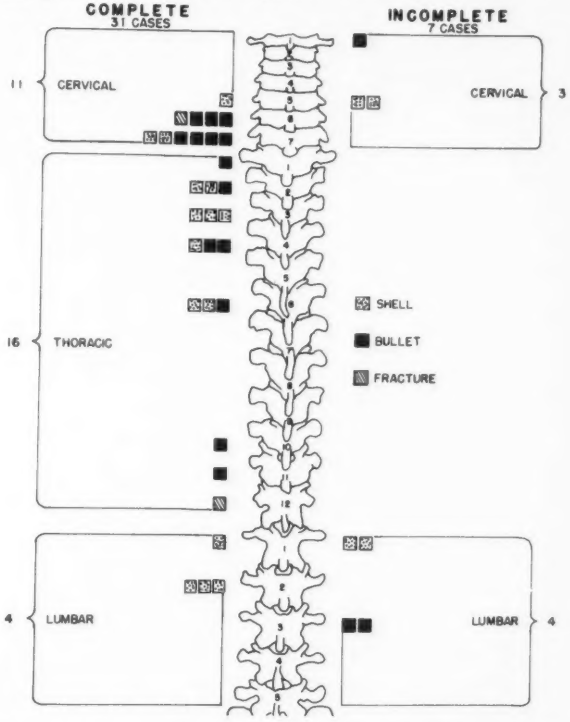



*Figure 17. Location, cause and extent of spinal cord injuries resulting in death overseas of 38 cases.*

ectomies with a total of 26 deaths, the mortality rate is 17 per cent. Since the completion of table 10, 10 more American cases have died. The causes of death were not obtained. It is very possible that, in this group of 201 cases, there were further deaths among the patients from other nations; again it was impossible to obtain additional records or later follow-up data. As might be expected, most fatalities occurred in the area of the cervicothoracic junction and bullets were the most frequently incurred cause (fig. 17).

## RESULTS AND OUTLOOK

In the fall of 1946, one to four years after the original injury, a follow-up of the surviving patients of this original group of 201 cases was attempted by mail or visit, with physical examination in home, hospital or at place of employment. Of the

original group of 174 American patients with spinal cord injuries, 126 were alive at that time. In spite of diligent search by the government agencies concerned only 80 patients, or about two-thirds of the group, could be found. The data are sobering (table 9).

TABLE 9. *Status of 80 patients with spinal cord injury one to four years later*

| Status of patients | 33 complete spinal cord injury cases | 47 incomplete spinal cord injury cases |
|---|---|---|
| Employed | 4 | 22 |
| In training | 2 | 1 |
| Unemployed, not in training | 27 | 24 |
| At home | 11 | 43 |
| Still hospitalized | 22 | 4 |
| Walking without aids | 2 | 36 |
| Walking with aids | 23 | 11 |
| Not walking | 8 | 0 |
| Normal bladder | 0 | 32 |
| Automatic or manageable bladder | 19 | 13 |
| Bladder drainage, urethral or suprapublic | 14 | 2 |
| Pain | | |
| In legs | 24 | 30 |
| In arms | 0 | 9 |
| In arms and legs | 4 | 4 |
| No pain | 5 | 4 |
| Bedsores | 16 | 1 |

It must be remembered that only one year had elapsed since the end of the war and many healthy young veterans were having a difficult time returning to a productive civilian existence. It is no surprise therefore to see the physically handicapped even less successful and slower in this attempt to rehabilitate themselves. In this struggle the patient's morale, resilience and will power are all important. The degree of motor and sensory loss, and the amount of pain are only indirectly responsible for success or failure on the difficult road to rehabilitation.

By 1946 most of the patients with complete spinal cord injuries were unemployed and only two were in training for a new job, both as watchmakers. A surprising number of patients with incomplete spinal cord injuries, over 50 per cent, also were still unemployed. Two-thirds of the patients with the complete spinal cord injuries were hospitalized, most of them were on urinary drainage and still had bedsores. Yet, with the exception of eight patients, all had made more or less successful attempts to walk, some with tremendous difficulty, trying to develop a strong enough shoulder girdle and sense of balance to master the swing-through gait. Over half of the patients with complete

spinal cord injuries had developed an automatic bladder and had learned enough about the peculiarities of their own reflexes to avoid embarrassment, soiling or discomfort. There were only nine patients who did not have pain from their spinal cord injury, regardless of whether it was complete or incomplete. Most patients had pain in their legs, and a few had pain in arms or in arms and legs. In some of the patients, pain was the greatest problem. Nerve root sections or spinothalamic tractotomies did not always give satisfactory relief. Alcohol injections, although quite successful, had at times the unfortunate effect of upsetting a well-adjusted automatic bladder, or causing the loss of penile erections.

Of considerable interest are the neurological findings in 52 patients seen one to four years after wounding (tables 10 and 11). While originally 80 cases were queried, only in 52 patients was it possible to make detailed neurological examinations and compare the patient's status as recorded at the time of injury with findings three months after treatment and from one to four years later. Table 10 brings out the importance of adequate decompression of the spinal cord, that is, the necessity of opening the dura if it is under tension and not pulsating after all extradural obstructions, such as laminal fragments, foreign bodies, and fluid collections have been relieved. This is illustrated by five incomplete and three complete spinal cord injury cases that failed to improve or even lost function after laminectomies in which the dura, although tightly enclosing the cord, was not opened. A considerable degree of recovery of function was shown in 15 other incomplete spinal cord injury cases. In these cases the dura was opened adequately, if under tension, to allow free flow of spinal fluid throughout the entire operative site. This flow can be stimulated by compression of jugular veins and is certainly a helpful test during the operative procedure. If the dura was found to pulsate it was left intact as nothing would have been gained by opening it.

The other more serious injuries with gross damage to the spinal cord (table 11) bring out two significant findings: first, that contrary to the previous group of cases (table 10), it was here not a question of difference in view point by the individual surgeon of whether to open or not to open the dura. The dura had already been torn, the spinal cord had either decompressed itself through that tear during the interval between wounding and operation or, where depressing laminal fragments or a foreign body prevented that, decompression of the spinal cord usually had taken place when all compressing overlying structures had been removed. The second finding was that in some cases, the cord would actually "discharge" toothpaste-like material leaving a shell of cord, which in the seven "complete" cases with direct damage to the spinal cord due to a foreign body (table 11) was

TABLE 10. *Effect of opened, pulsating or non-pulsating dura on operative result in 23 cases one to four years later*

| Laminectomy in World War II | | Spinal cord injury one to four years later | | | | |
|---|---|---|---|---|---|---|
| Operative findings | Spinal dura mater | Becomes complete | Worse | No change | Improved | Good result |
| Lamina fractured<br>Dura intact | Opened if pulsating, is left intact | | | | 4<br>Incomplete | 11<br>Incomplete |
| | Non-pulsating and is not opened | 2<br>Incomplete | 3<br>Incomplete | 3<br>Complete | | |

TABLE 11. *Effect of torn dura on neurological recovery of 29 patients with incomplete lesions one to four years later*

| Laminectomy in World War II; operative findings | Spinal cord injury one to four years later | | |
|---|---|---|---|
| | No change | Improved | Good result |
| Lamina fractured; dura mater torn;<br>foreign body inside or outside spinal canal | 5 complete | 1 "complete"<br>5 incomplete | 2 incomplete |
| Foreign body in spinal cord<br>or has perforated spinal cord | 6 complete | 4 "complete"<br>1 incomplete | 3 "complete" |
| Foreign body has transected spinal cord | 2 complete | | |

estimated to range from one-fifth to one-half of the total spinal cord substance at the involved level. That these cases did improve and changed from seemingly "complete" to incomplete spinal cord injuries[8] is proof of the benefit the cord derived from the evacuation of this material which gave the still viable and potentially functioning part of the cord a chance to recover. The degree of improvement is of course difficult to tabulate. While comparison of table 11 and the second group in table 7 brings out only one "complete" lesion out of 18 improved, the results in the more evident injuries, in which the foreign body lies inside the cord or has perforated it, are more impressive. Comparing the third group in table 7 with table 11, out of 45 injuries called "complete" up to three months after wounding, 7 changed into incomplete spinal cord lesions; of these 7 cases, 3 had regained the use, even if only partial, of both lower extremities; this does not take into account the considerable degree of improvement and good results seen in the 15 incomplete lesions of table 10 as compared with the findings in the 18 incomplete lesions of the second group in table 7.

An intentional decompression of the crushed spinal cord with release of devitalized cord substance, which in this series was done accidentally by bone fragments or foreign bodies, is not a new idea. Allan[9] published a nearly forgotten report almost 50 years ago on crush injuries of the spinal cord in two groups of dogs. Both groups had thoracic laminectomies, following this a weight was dropped onto the spinal cord that was still protected by dura. In one group of dogs, the dura was opened immediately, an incision made along the median sulcus and the wound closed; in the other group the wound was closed without further therapy. Most dogs in the first group regained normal function of their temporarily paraplegic hind legs, in the second group recovery of function was the exception. In work done on cats[5] with spinal cord injuries from bullets striking the tip of a thoracic posterior spinous process, but leaving the spinal canal and its contents grossly intact, a cavitation between the posterior columns of the spinal cord was produced with great regularity. That evacuation of this cavity or prevention of its formation would be responsible for the resumption of function in the less damaged part of the spinal cord seems an obvious conclusion.

No general statement can be made about the patient's attitude toward his illness; it ranged from complete apathy in some, to resentment and bitterness in others. High morale and eagerness to overcome their obvious difficulties were shown by a relatively small number of patients. A surprisingly large group of patients with incomplete spinal cord injuries seemed unable to resume an occupation in spite of seemingly not too great physical handicaps. All were, of course, eager to learn of any possible

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medical advances; they had formed groups for purposes of national and local representation, with their own newspapers, meetings, hobbies and sports. Paraplegics have received a good deal of publicity in the press, radio and cinema. The outlook is serious for most of them and they know it. They are alerted to constant care of themselves regardless of whether a new bedsore or another urinary infection is threatening. And while the main advance lies in better methods of rehabilitation, a new approach, still of very doubtful value, lies in actual "regeneration" or "suturing" of the damaged spinal cord,[10] which would be a revolutionary solution to a never-ending struggle.

## SUMMARY

A series of 201 patients with spinal cord injuries of World War II forms the basis of this study of a serious war injury. Advances in handling of this casualty since World War I, its diagnosis, treatment, complications, mortality and a follow-up of 52 patients one to four years after wounding are described.

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# GROUP PLANNING PRIOR TO DISCHARGE OF MILITARY PSYCHIATRIC PATIENTS

JACK A. DAVIS, *Captain, USAF (MSC)*

PATIENTS in a psychiatric ward of a military hospital have many realistic problems but the patients who are to be discharged from the armed services as a result of their psychiatric illness have many in addition. Some of these problems are similar to those of psychiatric patients at a civilian hospital but in many aspects they are unique. The patient is usually away from home and may not have the support of his relatives during his period of turmoil when he is struggling with many conflicting feelings about himself and the things that are happening to him. The patient often thinks that he has failed himself, his relatives, and the service. He feels rejected by his friends in the service, by his doctors, and by the armed services who now tell him that he is not qualified to serve.

The young recruit sees the service as a challenge. He is particularly resistive to returning to his home community a few months after enlistment and having to explain why he is back home so soon. He may equate his ability to remain successfully in the service with his masculinity. The more seasoned serviceman often looks to the service as a great father who expects service and obedience from him, but who in return offers security and status. He resents being sent from this protective environment to a civilian community that he has left years ago and which now seems cold, strange, and frightening. In the past, this veteran of many years of service may have been unusually critical of other servicemen who were "unable to take it." At the same time, the patient with many years of service believes that he has given a great deal to his country only to be thrown out now that he is no longer considered useful.

## FUNCTIONS OF SOCIAL WORKER

Some of the functions of a social worker in a hospital setting include helping the patient deal with realistic problems related to his illness and in helping him plan toward his release from

From U. S. Air Force Hospital, Lackland Air Force Base, Texas. Capt. Davis is now assigned to the U. S. Air Force Hospital Tachikawa, APO 323, San Francisco, Calif.

the hospital when he must grapple with vocational and social problems which have been altered as a result of his illness. The patient may look to the social worker as a friend with whom he may express his feelings of anger, resentment, helplessness, and dependence. The social worker often may help him to better understand the hospital procedures and regulations that may make little sense to him. He may experience acceptance on the part of the social worker who will help him to appraise his situation more realistically.

In order that the needs of psychiatric patients in a hospital setting be met more fully, predischarge planning on a group basis was initiated at this hospital late in 1957. It was believed that the values which would result from the group process[1-7] could not be secured by working on an individual basis. This large general hospital serves servicemen and their dependents from the far-flung bases, both in this country and overseas.

## GROUP COMPOSITION

Patients whom the ward psychiatrists had determined would be recommended for discharge from the Air Force as a result of their psychiatric illness composed the group. These patients needed to be well enough to participate to some extent in group discussion. Patients with various diagnoses were included, but those who were unusually paranoid were excluded. Some patients had only limited contact with their environment but seemed to have an awareness of what was going on in the group. After a few days, the social worker was able to judge whether the patient would be able to continue in the group with benefit. The size of the group varied from about 8 to 12. The composition and size of the group was constantly changing as patients left the hospital for civilian life and others were added.

## PROCEDURE

The responsibility for the group sessions was that of two Air Force social work officers. The leader was the chief social worker and the assistant was the closed ward social worker who frequently dealt with the patients in their daily contacts. The responsibility for the over-all activity rested with the leader. The assistant leader had a more intimate knowledge of each patient as a result of his daily contacts with them, and he knew what was happening to each one from the standpoint of administrative action taken toward discharge from the Air Force. Both workers would answer factual questions concerning the hospital, the administration, status of their cases, and knowledge of community resources. The senior leader had the responsibility for redirecting questions and helping the group to focus on problems which interested the group. The assistant worker also often participated in these functions.

Meetings usually were opened by having any new members introduced to the group. The new member might be asked to tell a little about himself. A simple explanation was made by the worker that the group met regularly twice a week in order that it might consider some of the problems that the patients faced here in the hospital as well as in their future civilian life. An invitation was then made for questions or suggestions from the group. Often problems which had come up since the last session were raised. Sometimes the patients had been thinking about issues brought up in a previous session which they wished to continue. A simple question often led to the topic for discussion for that day's session. Should no specific questions be raised, the leader was ready to explore with the group some areas of concern which might be of interest to them.

All members were encouraged to participate in each meeting. Usually, members responded spontaneously; however, some members were encouraged to express themselves by one of the workers suggesting to them that they might have some ideas about the subject or some experience which would be helpful to the group. Although most patients took an active part in discussion during the first session they attended, some needed to wait several weeks before they felt secure enough to participate.

Except for factual questions that usually were dealt with at the beginning of the session, the worker turned the questions that were raised back to the group for discussion.

## ROLE OF THE SOCIAL WORKERS IN THE GROUP

Feelings of rejection seem to be universal among psychiatric patients. These are heightened in the service because the patients are not able to make the decision as to whether or not they will be recommended for discharge. Feelings of rejection often are expressed by blaming former officers, the hospital personnel, and particularly the doctors who may have recommended discharge from the Air Force. The role of the social workers in the group activity was to give acceptance and understanding to the patient's feelings. In addition, they helped the group to explore areas of interest they know are the concern of most psychiatric patients leaving the service. The social workers help the patients deal with realistic problems while in the hospital, such as waiting for physical evaluation boards. They are a catalyst in stimulating thinking and discussion about problems without giving the groups the answers to such problems. They also are a resource for the group when it needs to know about available hospital services and community agencies which may help them work out a more satisfactory adjustment in the future.

The group discussions supplement the amount of individual casework that is given by the social workers. Patients are en-

couraged to bring their problems to the group rather than seek individual help. When further discussion with a patient is indicated, this is available. Group discussions also supplement the individual therapy which the patient receives from the psychiatrist or other members of the staff.

## EMPLOYMENT

One of the patient's chief areas of concern was that of finding a job once he entered civilian life. This problem often seemed insurmountable to veteran servicemen who had been out of touch with civilian industry for years. Many expressed hopelessness in being labeled psychiatric patients. The leaders brought into the discussion tangible resources such as the state employment services, the training available through the Veterans Administration, or through state rehabilitation agencies, positive and definite channels toward which members of the group could direct their energies. Many patients who recently had been in civilian life told of their civilian experiences in securing employment. Each member was encouraged to discuss his own background and his plans when he left the Air Force. When a patient expressed despair because of no definite resources or plans, other members of the group often supported him by their suggestions, such as, seeing relatives or friends for help in securing employment. The group feeling developed in all members and more frequently they saw their common problems. Many gained satisfaction out of being an authority in the group concerning some type of work. For example, one patient, a former salesman, secured a great amount of support and satisfaction by telling of his experiences in selling and suggesting to the others how they might get into this field. Some patients had feelings of competency in discussing their vocational field but little competency in other areas.

One of the baffling problems which patients on a psychiatric ward face is what and how much to tell a prospective employer about their illness. Nearly all feel that their illness will be a tremendous handicap. They often express their own feelings of worthlessness as a result of their psychiatric illness. Some declare their intentions to say nothing about past psychiatric illness and others suggested that the entire background must be explained in detail. During some sessions the patients practiced the process of applying for work by role playing, with one patient taking the part of the employer and the other of the employee. The experience related during the role playing showed that the patients had a need to give a great amount of information about their psychiatric illness even though it might not be required. Apparently, their own feelings of guilt about wanting to withhold information resulted in their telling more than normally would be expected.

Many of the patients were unrealistic about employment opportunities. They thought in terms of skilled jobs and high salaries but at the same time believed that they were not ready to handle any kind of a job. The discussions were focused to help the members of the group assess their own potentialities and make realistic plans towards securing employment.

## FAMILY

Next to employment, the neuropsychiatric patients were concerned with their families. Many patients, particularly those who had difficulty in accepting their illness, postponed telling their relatives about it. They may have explained their condition by suggesting in their letters that they were in the hospital for an upset stomach or headache. Others in the group frequently challenged such behavior and helped the patient to deal more realistically with relatives. Patients often told of the acceptance of their illness by their relatives, which in turn gave other patients who had postponed writing relatives the facts more courage to deal with reality.

Most patients were able to recognize that they needed the support of others, which usually came through family relationships. They frequently described their feelings of being left out and of not being needed.

## SOCIAL RELATIONSHIPS

During group sessions much concern about social relationships seemed to be expressed. Many patients were concerned as to what people would think about their illness once they reentered the civilian community. One patient opened a session by the following statement: "Everyone says and does some peculiar things at times, but if we as former psychiatric patients do these things, people will say that we are still crazy." Many of the patients had isolated themselves in the past and had little awareness of their need to associate with others in the community if they were to experience good mental health. The function of assisting with routine ward tasks and recreational activities in the hospital were discussed to help the patients recognize their need for activity and social contacts which were satisfying and supporting. The likelihood of a patient finding activities of a similar nature in his church, club, or settlement house were discussed. Again role playing was used to help the patient visualize his first contacts with old friends in the home community. The patients in role playing were given the opportunity to walk down the street and meet an old friend portrayed by another patient. His own explanation as to how he would handle this meeting was encouraged.

## MENTAL HEALTH

Most patients in the group expected to stay mentally well. Some however, had experienced one or more previous episodes and had some concern about their ability to stay well. Patients were encouraged to discuss their own ideas about the reasons why they became ill. Usually, the assignment in the Air Force was given as the cause. In addition, limited recreation, separation from family, and overseas duty were often included. Patients developed awareness of some of the types of stress which may contribute to psychiatric illness. They were helped to consider how they might avoid becoming ill in the future. Many believed that they would have no difficulty once they were away from the military environment. Most seem to recognize that they must seek help in the future if problems developed in such a way that they felt unable to cope with them. The group usually came to recognize that they should seek a physician, clergyman, social worker, or friend with whom they might share their problems. The leaders had discussed with the group the social resources found in most communities such as the aid of the family physician, Veterans' Administration services, clinics, hospitals, social agencies, clergymen, and counselors.

## EVALUATION

Patients who were about to leave the group through discharge were interviewed individually to secure their assistance in evaluating their experience in participating in the group. Most thought that the opportunity to express their feelings to others who were receptive and understanding was of greatest value to them personally. Others stated that an important benefit of group participation was that it helped them to recognize that others had experiences and problems similar to theirs as a result of illness. Most expressed the recognition of having similar problems by saying that they had decided that they were not so different after all. Some patients said the group feeling cohesiveness gave them security to move ahead when they had been unable to do so previously. Others mentioned that their plans now had had an opportunity to crystallize as a result of discussion, role playing, and a better knowledge of community resources.

As a result of the group activity on the ward, patients seemed less restless and their attitudes toward the hospital personnel improved. Many would continue discussions which were originally begun during the scheduled group sessions. Others would bring to the group for discussion controversial issues which had occurred on the wards. Some who had formerly isolated themselves formed relationships with other group members. Patients looked forward to the sessions and would ask the social workers about the next session when they met in the hall. The greatest test

of the group's effectiveness, which has not been measured, would be the adjustment that these patients make in civilian life.

## SUMMARY

Patients on a psychiatric ward, who are to be discharged from a military service, undergo a period of transition accompanied by stresses which include feelings of rejection, weeks of waiting with a limited understanding of what is happening to them, concern about entering the civilian community in which they must secure employment, and the problems of adjusting to friends and relatives. Predischarge planning on a group basis enables the patient to express feelings about himself. It helps him to better understand what is happening to him administratively. It gives him a feeling of companionship and security with others whom he finds have had experiences during their illness similar to his own. It helps the patient explore the problems which he will meet in civilian life and to develop his own solution to these problems. The social worker must accept members of such a group with understanding, act as a catalyst in discussions without giving the solutions, and serve as a resource concerning both the hospital and its facilities and the agencies in the civilian community which may be needed in the patient's future rehabilitation.

Predischarge planning on a group basis can be used effectively and more widely with types of patients who have experienced prolonged hospitalization and severe illnesses. Groups may include both patients who are being discharged from the service and those who need to be psychologically prepared to meet the problems of returning to duty.

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# Dermoid Cyst of Thyroid Gland in an Adult

GERARD NOTEBOOM, *Captain, MC, USAR*
ERICH A. EVERTS-SUAREZ, *Captain, MC, USAR*

TERATOID TUMORS of the thyroid gland are rare. Herbut[1] classified teratoid tumors in general as epidermoid cysts; consisting of ectoderm only; dermoid cysts, consisting of ectoderm and mesoderm; and teratomas, consisting of ectoderm, mesoderm, and entoderm. Recently, we found a dermoid cyst of the thyroid gland in a 19-year-old youth, which is reported because of its rarity.

## REVIEW OF LITERATURE

Teratoid tumors in or in the vicinity of the thyroid gland are mainly embryonal teratomas, which have occurred in stillborns, newborns, and infants.[2-22] There are only four reported cases in adults. In 1908, Lurje[3] described a malignant teratoma of the thyroid gland in a 53-year-old woman. The following year, Waechter[24] described a "carcino-sarcoma" of the thyroid gland in a 71-year-old man. The multiplicity of tissues found in the tumor, however, forces one to consider it as a malignant teratoma. Eleven years later (1920) Fritzsche[25] reported a malignant teratoma of the thyroid gland in a 41-year-old woman. In 1954 Buckwalter and Layton[26] described a malignant teratoma of the thyroid gland in a 23-year-old woman. Two instances of dermoid cysts in the region of the thyroid gland are recorded in the literature, one by Crotti[27] in 1922 and a second by Greene[28] in 1925. Greene's patient was an adult. Microscopically both cysts were lined by skin with sebaceous and sudoriparous glands but lacked the presence of thyroid tissue in the wall, making them unacceptable as true cases of dermoid cysts of the thyroid gland. In 1956, Goldberg and Harvey[29] wrote an article on squamous cell cysts of the thyroid gland. These also differ from dermoid cysts in that they lack skin appendages and thyroid tissue in the cyst wall. Perusal of the literature has failed to reveal any other similar cases. There are no recorded cases of true dermoid cysts of the thyroid gland.

## CASE REPORT

A 19-year-old man was admitted to this hospital on 18 August 1958 because of fainting spells. At the time of examination a firm nodule

From Second U. S. Army Medical Laboratory, Fort George G. Meade, Maryland. Dr. Noteboom is now at 1200 Hurley Avenue, Fort Worth, Texas.

was palpated in the right lobe of the thyroid. The nodule moved with deglutition. No other masses in the thyroid were palpated. The remaining physical examination findings, all laboratory studies, a roentgenogram of the chest, and electrocardiograms were normal. On 8 September the patient was submitted to surgery under general anesthesia. At operation the left lobe of the thyroid was palpated and was thought to be within normal limits. The right lobe contained a cystic mass in the anterior surface of the superior pole. This mass was sup-

*Figure 1. Cut surfaces of dermoid cyst showing hairs and grumous material in lumen.*

plied by branches of the superior thyroid artery. After ligating the right arterial and venous branches to the gland, a right hemithyroidectomy was performed. In addition, the isthmus of the thyroid was excised at its junction with the left lobe. The operative site was closed following the usual procedure. The patient left the operating room in good condition.

## PATHOLOGIC FINDINGS

Macroscopically the specimen revealed a portion of thyroid gland, weighing 10 grams and measuring 4 by 2.5 by 3 centimeters. It had been fixed in alcohol and was pyramidal in shape. On the anterolateral aspect was a cystic mass, 2 cm in diameter. It produced a semilunar depression in the right lobe of the thyroid. This mass was adherent to the gland and covered by the true capsule of the thyroid. A small opening had been surgically produced in the anterior surface of the mass. Through the incision an abundant amount of grumous white ma-

terial was visible. The cystic mass was separated from the rest of the thyroid tissue with only slight difficulty. The cyst was lined by a pink-gray membrane, 0.1 cm in thickness. It contained a mixture of hairs and white amorphous material (fig. 1). The rest of the thyroid tissue had a beefy red cut surface. No other cystic or nodular masses were present.

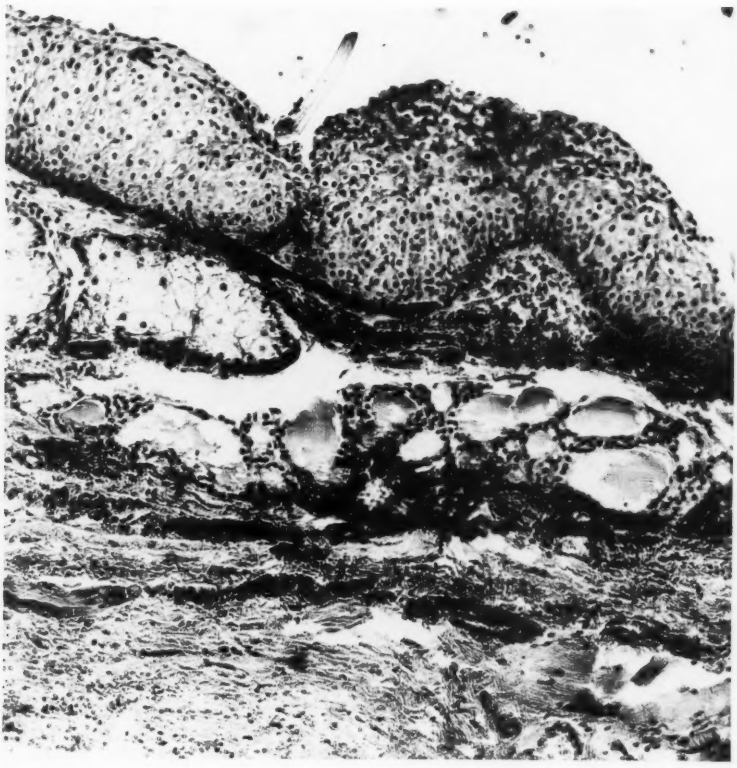

*Figure 2. Note squamous epithelium lining cyst, sebaceous glands, and thyroid acini in wall.*

Microscopic examination revealed the cyst to be lined by low squamous epithelium which rested on connective tissue containing sebaceous glands and thyroid follicles (fig. 2). The thyroid acini present in the wall of the cyst were of average size, lined by cuboidal to flattened epithelium, and contained abundant amounts of colloid in the lumen. The rest of the thyroid gland showed no areas of hemorrhage or tumor nodules.

## DISCUSSION

The two criteria for accepting the thyroid gland as the site of origin of a teratoid tumor as given by Bale[20] are that the vascular supply of the tumor be derived from thyroid vessels, and that thyroid gland tissue be present in the wall of the tumor. In the present case the tumor was attached to the thyroid gland, covered by its true capsule, and received its blood supply from the superior thyroid artery. The tumor therefore fulfills the enumerated criteria.

In order to understand the possible histogenesis of a dermoid cyst in the thyroid, it is necessary to review the embryologic development of the gland. Near the end of the fourth week of embryonal development, the median thyroid diverticulum arises from the floor of the pharynx between the first and second pharyngeal pouches. This primordium becomes bilobed and moves caudal along the ventral aspect of the pharynx. By the seventh week it is down at the level of the primitive larynx and consists already of lateral lobes with a narrow isthmus. On the caudal aspect of the fourth pharyngeal pouch are developing small diverticula, which by some are considered as rudimentary fifth pharyngeal pouches. There is strong evidence that these "postbranchial bodies" become part of the thyroid gland and are included in the substance of the gland. It seems possible that in our case the right postbranchial body, for reasons unknown, failed to follow its normal course and developed into a dermoid cyst.

## SUMMARY

Teratoid tumors of the thyroid gland are rare. There are only four recorded instances of these tumors in adults. All four cases were malignant teratomas. The first known case of a benign dermoid cyst of the thyroid gland in an adult is presented. A brief discussion as to the pathogenesis of the condition is given.

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## THE ENTERPRISE OF FREE MEDICINE

There are few people today that would deny that the United States has the best medical care in the world, and it certainly has the best teaching centers. Students are now coming to this country for study whereas before the war many students were going to the European centers for training. It is no coincidence that this is the only major country in the world where the enterprise of free medicine still exists. One cannot escape the conclusion that good medical care and freedom go hand in hand, and that good care cannot exist in an atmosphere devoid of freedom. —John Reid Brown: Private Practice of Medicine, *Detroit Medical News.* March 2, 1959.

# Impending Crisis in Addison's Disease During Oral Surgery

JOHN D. LEWIS, *D. D. S.*
CHARLES A. McMAHON, *Major, USAF (DC)*
A. F. BLOODWORTH, *Captain, USAF (MC)*

PATIENTS with Addison's disease are known to tolerate stress very poorly. The physician, however, is frequently surprised at the small amount of stress required to actually precipitate a condition of impending crisis. In the following case there was a history of three previous episodes of crisis.

## CASE REPORT

On 4 October 1956, a 43-year-old white woman was admitted to this hospital for oral surgery. The patient stated that she had consulted several dentists in the community regarding a painful abscessed tooth, but upon learning that she was under medical treatment for Addison's disease, none of the dentists would consider treating her. The last dentist with whom she consulted referred her to an oral surgeon, who recommended hospitalization and medical consultation prior to extraction of the tooth.

Past history revealed that the diagnosis of Addison's disease had been suspected and later confirmed in September 1953, at the William Beaumont Army Hospital, Fort Bliss, Tex., where the patient was admitted in a comatose state. It was this profound, shocklike state of the patient and the marked pigmentation of her skin and mucous membranes that caused them to suspect this disease. This was further supported by the response to treatment with normal saline infusions, and lack of adrenal cortical stimulation with adrenocorticotropic hormone (Thorn test).

Upon recovery from the initial coma, the patient stated that a bilateral salpingectomy had been performed at the age of 22, and that the pathologic diagnosis on the surgical specimen was "tuberculous salpingitis, with peritonitis." During the time between that surgical procedure and the initial episode of coma no other signs or symptoms of tuberculosis were noted. A roentgenogram of the chest at the time of initial coma did not reveal any evidence of active disease.

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From U. S. Air Force Hospital, Lake Charles Air Force Base, La. Dr. Lewis, consultant in oral surgery, is at 442 South Ryan Street, Lake Charles, La.

After the diagnosis of Addison's disease had been made, the patient had been placed on graded daily oral doses of cortisone, the dosage finally being regulated to 12 ½ to 25 mg daily. The patient seemed to do very well on this except during periods of mental or physical stress, at which times it became necessary to add extra salt to her diet.

*Figure 1. Pigmentation of the labial mucosa of the superior maxillas.*

*Figure 2. Pigmentation of the gingival mucosa of the mandible.*

Two more episodes of coma, one in October 1954 and another in June 1955, are recorded between the initial episode and admission to this hospital on 4 October 1956. For several days prior to the October 1956 admission to this hospital for oral surgery, the patient noted occasional pain with associated soreness in the region of the left mandible.

Physical examination on admission to the hospital revealed a well-developed, well-nourished white woman. There was no marked asymmetry of her face and jaws. Her skin was a bronze to brown color. There was no evidence of eruptions, scaling, subcutaneous nodules, or telangiectasis. Her eyes, ears, nose and throat appeared benign. There was no significant lymphadenopathy. Intra-oral examination revealed marked pigmentation about the margins, as well as the labial and buccal surfaces of the gingival mucosa, both superiorly and inferiorly (figs. 1 and 2). The teeth appeared to be in satisfactory repair except for the mandibular left second and third molars, which contained carious lesions about the coronal surfaces. Pain was definitely

present on percussion of the mandibular left second molar tooth. It also was found to be slightly mobile and elevated. Removal of the left second mandibular tooth was believed to be indicated.

The patient was hospitalized for four days prior to scheduled surgical procedure. During this time she received antibiotic therapy and a step-up in oral cortisone dosage to 75 mg daily. On 8 October at 1030 hours, under preoperative medication of 100 mg of Demerol hydrochloride (brand of meperidine hydrochloride), the patient was taken to the operating room. While being moved from the stretcher to the operating table, the patient vomited a large amount of yellowish fluid. This resulted in some degree of weakness, inasmuch as the patient was in a fasting state prior to premedication, plus the fact that the morning dose of cortisone and a significant quantity of electrolytes were presumably lost in the emesis.

*Figure 3. Operative site on seventh postoperative day.*

Initial blood pressure on admission to the hospital was 110/70 mm Hg. The blood pressure recorded upon entering the operating room was 100/60 mm Hg. At this point an infusion containing 1.000 ml of 5 per cent dextrose in normal saline solution, to which had been added 30 ml of aqueous adrenal cortical extract, was started. This was allowed to drip at the rate of 30 to 40 drops per minute. Under observation of an internist, the patient was prepared for surgery. Blood pressure recordings were made at 3 to 4 minute intervals and found to be stable at 100 mm Hg systolic and 60 diastolic. A left mandibular block was performed, using 2 per cent xylocaine hydrochloride (brand of lidocaine hydrochloride) with epinephrine 1/100,000. About 4 minutes following the injection of 1 ml of the local anesthesia, the patient complained of rapid beating of the heart and associated palpitations of the chest. All manipulations ceased. Blood pressure was recorded

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at 75 mm Hg systolic and 50 diastolic. The pulse rate was 100 per minute, equal and regular.

One hundred milligrams of Solu-Cortef (brand of hydrocortisone sodium succinate) was incorporated into the intravenous fluids and the infusion allowed to run freely. Blood pressure was again recorded at 60 mm Hg systolic and 40 diastolic. Blood pressure was then recorded at 30-second intervals, and over a period of 4 to 5 minutes it gradually rose to the preoperative level of 100/70 mm Hg. Concurrently the patient stated that she was greatly improved symptomatically, and the oral surgeon was allowed to continue. Under local anesthesia, the mandibular left second molar was extracted by means of forceps without difficulty.

*Figure 4. Patient's hand, on the right, as compared with the hand of an average white woman.*

Over the next 24-hour period only slight bleeding from the operative site was observed, and the patient was allowed to continue her usual method of steroid maintenance. Forty-eight hours following the procedure she was discharged to her home. Figure 3 shows the operative site on the seventh postoperative day. Appearance of the patient's hand is shown in figure 4.

## COMMENT

In this case the cause was believed to be tuberculosis, on the basis of pathologic diagnosis at the time of gynecologic surgery. The importance of preoperative steroid preparation, preferably by the parental route, is obvious. The oral surgeon does not encounter this situation too often, fortunately. However, when it does occur, the combined management of the patient by the oral surgeon and physician is recommended.

# GEN. HEATON NEW ARMY SG; GEN. GORBY TO COMMAND WRAMC, GEN. COONEY TO URAREUR

Major General Leonard D. Heaton, commanding general of Walter Reed Army Medical Center since 1953, succeeded Major General Silas B. Hays, as surgeon general of the Army on 1 June.

General Heaton is a distinguished military surgeon. In June 1956 he operated on President Eisenhower and in November 1956 and February 1959, on former Secretary of State John Foster Dulles. He is a fellow of the American College of Surgeons, and a member of the American Surgical Association. He has been certified by the American Board of Surgery since 1948. He was the tenth commander of Walter Reed Army Medical Center, which includes Walter Reed Army Hospital, Walter Reed Army Institute of Research, and the Army Central Dental Laboratory and Prosthetics Research Laboratory.

Born in Parkersburg, W. Va., General Heaton received his medical degree from the University of Louisville, Ky., in 1926. He received his commission as a first lieutenant in the Regular Army in 1927, after serving an internship at Letterman Army Hospital, San Francisco. He graduated from the Army Medical School and Medical Field Service School in 1929, and is a graduate of the Command and General Staff

*Major General Leonard D. Heaton, Surgeon General of the Army, left, and his predecessor, Major General Silas B. Hays.*

School. When Pearl Harbor was attacked in December 1941, General Heaton was chief of surgical service at North Sector General Hospital, Schofield Barracks, Hawaii. In 1942 he was transferred to Woodrow Wilson Hospital, Staunton, Va., and was later given command of the 160th General Hospital which he took to Europe in March 1944. At the end of the war, General Heaton headed the 802d Hospital Center in Blandford, England. He served successively as chief of surgical services, director of professional services, and commanding general of Letterman Army Hospital between 1945 and 1953. His military decorations include the Distinguished Service Medal and the Legion of Merit with second oak leaf cluster.

*Major General James P. Cooney, MC, USA, chief surgeon, U. S. Army, Europe.*

*Major General Alvin L. Gorby, MC, USA, commanding general, Walter Reed Army Medical Center*

General Heaton's successor at Walter Reed Medical Center is Major General Alvin L. Gorby, chief surgeon of U. S. Army, Europe. General Gorby is a native of Spencer, W. Va., and received his medical degree at the University of Oklahoma in 1925. He was commissioned as a first lieutenant in the Regular Army in 1928, after interning at Letterman Army Hospital. He graduated from the Army Medical School and the Medical Field Service School in 1927, and from the Command and General Staff School in 1936.

Major General James P. Cooney, deputy surgeon general of the Army for the past four years, is the new chief surgeon of the Army in Europe. A native of Parnell, Iowa, he received his medical degree in 1927 from the University of Iowa. In 1929 he graduated from the Army Medical School and the Army Medical Field Service School. He has achieved

distinction as an authority in radiology and atomic medicine. In 1946 he was assigned to the Manhattan Engineering District to train for the Bikini tests and participated in numerous radiological surveys. After Bikini he was sent on a special mission to Japan to study the A-bomb survivors at Hiroshima and Nagasaki. Before becoming deputy surgeon general, he served as commandant of the Medical Field Service School.

General Hays, surgeon general of the Army since 1955, is a native of St. Paul, Minn., and received his medical degree from the University of Iowa in 1928. He was commissioned as a first lieutenant in the Regular Army in 1929, graduated from the Army Medical School and Medical Field Service School in 1931, and the Army Industrial College in 1940. He served two tours of duty in the supply division, Office of the Surgeon General, one as its chief; as chief of medical supply in the European Theater of Operations; as Surgeon, U. S. Army, Pacific, and as surgeon of the Japan Logistical Command. In 1951 he was recalled from Japan to become deputy surgeon general.

The notable accomplishments of General Hays' administration include the establishment of the Office for Dependents' Medical Care (MEDICARE) on 7 December 1956, to provide medical care in civilian facilities for dependents of military personnel on active duty; the organization of the Army Medical Research and Development Command; and, as part of the Army Medical Services' gradual shift from hospital care to the treatment of more patients on an ambulatory or outpatient basis, the establishment of the Army health record in 1957 to provide a comprehensive and continuing medical history of each individual on active duty. Seven new hospitals were constructed and dedicated while General Hays was surgeon general. He plans to retire next month.

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## RESEARCH GROUP ELECTS CAPT. ENGLISH

Captain James A. English, DC, USN, head of the dental branches, Office of Naval Research, and Research Division, Bureau of Medicine and Surgery, was elected as vice president of the International Association for Dental Research during the group's recent meeting in San Francisco. He has served in the Naval Dental Corps since 1936, when he received his degree in dentistry from the University of Pennsylvania.

*Captain English*

He has served as science liaison officer, Office of Naval Research, London, and is author or co-author of a number of published articles in the field of dental research.

# CAPT. CHENAULT, GEN. KENNARD ELECTED OFFICERS OF AEROSPACE MEDICAL ASSN.

The Aero Medical Association, headed for the past year by Brigadier General M. S. White, USAF (MC), changed its name to the Aerospace Medical Association by vote of the members at the thirtieth annual meeting at the Statler Hilton Hotel, Los Angeles, 27-29 April. The association's monthly journal will hereafter be known as *Aerospace Medicine.*

*Dr. Phoebus*

*Dr. Ruff*

*Dr. Lamb*

*Dr. Beckman*

Navy and Air Force medical officers won the four awards, named in memory of pioneer flight surgeons, which are given annually by the Association. Captain Clifford P. Phoebus, MC, USN, Naval War College, Newport, R. I., received the Theodore C. Lyster Award for outstanding achievement in the general field of aerospace medicine. He was also inducted as the chairman of the Space Medicine Branch of the Association. The Raymond F. Longacre Award was given Captain George E. Ruff, USAF (MC), Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio, for his work in testing of Project Mercury candidates. Lawrence E. Lamb, M. D., head of the department of internal medicine, U. S. Air Force School of Aviation Medicine, won the Arnold D. Tuttle Award for his extensive contributions to aviation cardiology. The Eric Liljencrantz Medal went to Captain Edward L. Beckman, MC, USN, now on duty at the Royal Navy Institute of Aviation Medicine, Farnborough, England, for his valuable research in the effects of acceleration on man.

Captain Oran W. Chenault, MC, USN, assistant chief of the Bureau of Medicine and Surgery for aviation medicine, was chosen first vice president of the Association. Major General Oliver K. Niess, surgeon general of the Air Force, was elected to the executive council for a three year term, and Brigadier General William J. Kennard, USAF (MC) (Ret.), Arlington, Va., was selected secretary-treasurer. Generals Niess and Kennard, and the following other Medical Corps officers, were elected to fellowship, the society's highest grade of membership: Colonel Harold V. Ellingson, USAF; Captain Ross B. Lautzenheiser, USN; Captain F. Kirk Smith, USN; Captain John T. Smith, USN; and Colonel John M. Talbot, USAF.

## ADMIRAL PUGH WRITES AUTOBIOGRAPHY

Rear Admiral H. Lamont Pugh, MC, USN (Ret.), Surgeon General of the Navy, 1951-1955, has recently had his autobiography, *Navy Surgeon*, published by J. B. Lippincott and Company, Philadelphia, Pa. Admiral Pugh, who now lives in Virginia, served his country in three wars: as a Marine in World War I, as a Naval surgeon and administrator during World War II, and as Surgeon General of the Navy during the Korean conflict. His autobiography gives an eyewitness account of the progress of American society from the oxcart of his Virginia boyhood to the jet plane, and the comparable progress in medicine from the use of maggots to control gangrene to penicillin, antibiotics, and modern medical and surgical methods.

*Admiral Pugh*

A fellow of the American College of Surgeons since 1934, Admiral Pugh was the only member of the regular Navy who was certified by the American Board of Surgery when he was appointed as Chief of Surgical Services at the U. S. Naval Hospital, Pearl Harbor, in 1942. Eight months later he became Chief of Surgical Services at the U. S. Naval Hospital, San Diego, Calif., then the largest Navy hospital in the United States.

In 1944, Admiral Pugh became commanding officer of the U. S. Naval Medical School at Bethesda, Md., and two years later was appointed Assistant Chief of the Bureau of Medicine and Surgery and Deputy Surgeon General of the Navy.

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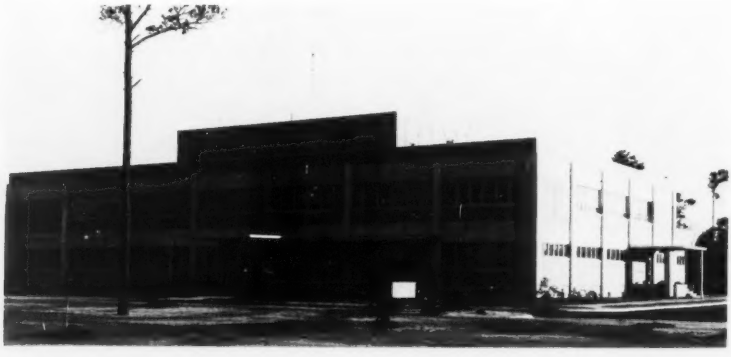
## AIR FORCE OUTSTANDING UNIT AWARD

The First Aeromedical Transport Group (MATS), Brooks Air Force Base, Tex., recently received the Air Force Outstanding Unit Award, for exceptionally meritorious service of national significance to humanity during the period 1 February 1953 to 31 December 1957. The only unit of its kind in the Air Force, the group, commanded by Colonel Luther B. Matthews, provides air transportation for patients of all branches of the Armed Forces within the United States. During the five-year period covered by this award the unit completed more than 240,000 patient movements and logged more than 200,000 flying hours without injury or loss of life by accident.

**RETIRED.** Rear Admiral Irwin L. V. Norman, MC, USN, left, Inspector General of the Medical Department Activities, Bureau of Medicine and Surgery, retired 1 May, after more than 31 years of service in the Navy. Brigadier General Robert E. Lee, USAF (MC), former surgeon of the Tactical Air Command, retired in April after almost 33 years as an Air Force medical officer.



**MYRTLE BEACH.** This two-story, air-conditioned hospital, offering medical, surgical, and obstetric facilities for inpatient care and clinics in internal medicine, obstetrics and surgery for outpatient service, was opened 1 March 1959 at Myrtle Beach Air Force Base, S. C. Colonel Paul E. Lance, USAF (MC), is commander of the new 50-bed facility.

**AUSTRALIAN VISITOR.** Dr. Reginald Francis Matters, chairman of the State Commission of the Royal Australian College of Surgeons, is greeted by Captain Frank P. Kreuz, MC, USN, left, commanding officer of the U. S. Naval Hospital, Bethesda, Md., and Commander Thomas B. Lebherz, MC, USN, head of the obstetrics and gynecology service. During his recent visit Dr. Matters observed the resident training program in obstetrics and gynecology at the hospital.

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## DR. McGANITY ATTENDS BEIRUT MEETING

Dr. William J. McGanity, professor of obstetrics and gynecology at Vanderbilt University School of Medicine, and consultant to the Interdepartmental Committee on Nutrition for National Defense, spoke on "Nutrition in Relation to Public Health," at the Ninth Middle East Medical Assembly held 8-10 May at the American University in Beirut, Lebanon. Officers of U. S. Naval Medical Research Unit Number 3, Cairo, Eygpt, participating in the meeting included Commander Robert E. Fultz, MC, USN, who discussed current research on treatment of Schistosomiasis and Brucellosis; Lieutenant Commander Max E. Musgrave, MC, USN, who monitored the scientific exhibit "Treatment of Shigellosis with Furoxone;" and Lieutenants Thomas G. Akers and Noel L. Freeman, MSC, USN, who presented papers on "Poliomyelitis in Cairo, Eygpt, U. A. R. during 1958 " and "Hemagglutination Studies with Schistosoma Hematobin Antigens," respectively.

**MEDICAL ANTIQUE.** When bloodletting was a "cure-all" of the times—a tonic for the healthy and a cure for the ailing—the small 16-blade instrument held by Colonel Frank M. Townsend, USAF (MC), was in common use. Called a scarificator, it was used to make the slight cuts in the skin necessary for this type of therapy, which was frequently performed by barbers of the period during the 18th and early 19th centuries. This scarificator was presented to the Medical Museum of the Armed Forces Institute of Pathology by Mr. and Mrs. B. Woodruff Weaver, right, of Washington, D. C., on behalf of their uncle, Colonel Theodore Barnes, USA,(Ret.), now living in Florida. The items in front of Col. Townsend are part of the display of antique scarificators at the Museum. Col. Townsend is deputy director of the Institute of Pathology.

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## GENERAL BENSON GIVES ANDERS LECTURE

The 1959 Anders Lecture, "Man in Space—The Medical Problem," was delivered before the Philadelphia College of Physicians on 1 April, by Major General Otis O. Benson, USAF (MC), commandant of the U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas. The annual lecture is named in honor of Dr. James M. Anders, a former president of the American College of Physicians.

# Progress Notes

Colonel **Louis K. Mantell**, MC, USA, is course director of the annual James C. Kimbrough Urological Seminar at Brooke Army Hospital, Fort Sam Houston, Tex., 2-4 November 1959. Those desiring to participate should submit titles and 50-word abstracts to Col. Mantell at Brooke Army Hospital by August 15. . . . .Captain **Thenton D. Boaz**, MC, USN, will retire from the Navy next month after 30 years of service as a flight surgeon and hospital commander. . . . .Colonel **Arthur B. Tarrow**, USAF (MC), is moderator of the sixth annual anesthesiology review course at the U. S. Air Force Hospital at Lackland Air Force Base, Tex., where he is chief of anesthesiology, 8-13 June. Appearing on the instructors panel in addition to members of the hospital staff will be: Drs. **John Abajian**, University of Vermont College of Medicine, **Charles R. Allen**, and **George W. N. Eggers**, University of Texas Medical Branch, **John W. Winter** and **Robert C. Peterson**, consultants in anesthesiology to Lackland Air Force Hospital and Brooke Army Hospital, **Max S. Sadove**, University of Illinois College of Medicine, and Major **Paul Teschan**, MC, USA, Brooke Army Medical Center, Tex. . . . .Captain **Ashton Graybiel**, MC, USN, director of research at the Naval School of Aviation Medicien, Pensacola, Fla., spoke on the role of diet in managing coronary heart disease at a symposium on nutritional problems in medicine, sponsored by the American Medical Association's Council on Foods and Nutrition and Vanderbilt University, in Nashville, Tenn., on May 8. . . . .Colonel **Frank M. Townsend**, USAF (MC), deputy director of the Armed Forces Institute of Pathology, recently spoke on "Evaluation of Aeronautical Data in Accident Cases—Government Accident Investigation Procedures, Records, Regulations, Sources of Data." at the University of Denver College of Law, Denver, Colo. . . . .Lieutenant Colonel **Nathan Cooper**, USAF (MSC), principal preceptor for the Air Force hospital administration training and residencies, attended a meeting of the Association of University Programs in Hospital Administration in Pittsburgh, Pa., 7-9 May. . . . .Papers were presented at the annual meeting of the Federation of American Societies for Experimental Biology in Atlantic City, N. J., by the following staff members of the Armed Forces Institute of Pathology: Drs. **Vaman S. Waravdekar**, **Arthur M. Silverstein**, **Hans F. Smetana**, **Richard H. Follis, Jr.**, **Lalla Iverson**, and **Leo R. Goldbaum**. . . . .Captain **Dwight A. Callagan** and Lieutenant **Charles A. Novotny**, MC, USN, and Lieutenant **William K. Hass**, MC, USNR, U. S. Naval Hospital, Portsmouth, Va., presented a paper on their studies using the electroencephalograph to detect fetal heart impulses at the recent annual meeting of the American College of Obstetrics and Gynecology in Atlantic City, N. J. . . . .Professor **Jack Adams-Ray**, chief of surgery at the Karolinska Hospital, Stockholm, Sweden, and writer and research worker in the pathophysiological approach to surgery, spoke on "The Chromaffin Granule Cell System in Human Skin." at an open lecture at the Naval Medical School, Bethesda, Md., during an April visit to the United States. . . . .One hundred and twenty five military and civilian physicians attended a

five-day postgraduate seminar in cardiovascular pathology at the Armed Forces Institute of Pathology during April. Participants were from the U. S., Venezuela, Canada, India, England, Argentina, and the Phillipines. Dr. **William C. Manion**, chief of the cardiovascular pathology branch of AFIP was the seminar director. . . . .A new, color documentary on the Naval Dental Corps is being filmed at the Naval Medical Center in Bethesda, Md., and at the Naval Hospital in San Diego, Calif., for use as an unclassified training film. Captain **John V. Niiranen**, DC, USN, is the technical advisor in Bethesda. . . . . Colonel **Alvin F. Meyer, Jr.**, USAF (MSC), senior industrial hygiene engineer, Office of the Surgeon, Headquarters Strategic Air Command, Offutt Air Force Base, Nebraska, has been elected chairman of the Offutt Chapter of the Institute of Aeronautical Sciences. . . . .Captain **William M. Silliphant**, MC, USN, director of the Armed Forces Institute of Pathology; his deputy, Colonel **Frank M. Townsend**, USAF (MC); Major **Frederick W. Lovell**, USAF (MC), chief of the aviation pathology section; and Captain **William M. Glantz**, USAF (MC) of the forensic and aviation pathology branch participated in the thirtieth annual meeting of the Aerospace Medical Association in Los Angeles in April.

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## Officers Certified by Specialty Boards

The Surgeons General of the military medical services have announced that the following regular Medical Corps officers have been certified by the boards indicated.

### American Board of Internal Medicine

Caris, Timothy N., Maj., USAF
Kolb, Earl J. Jr., Capt., USAF
Melton, Joseph T., Maj., USAF
Ord, John W., Capt., USAF

### American Board of Orthopedic Surgery

Ainsworth, George E., Maj., USAF

### American Board of Pediatrics

Plunket, Daniel C., Capt., USA
Strominger, Donald B., Capt., USAF

### American Board of Psychiatry and Neurology

*Psychiatry*

Flaherty, Bernard E., Lt. Col., USAF

### American Board of Radiology

Ellswood, William H., Maj., USAF
Talley, William C., Capt., USAF

*Medical Nuclear Physics*

Hale, Carl R., Capt., USA
Hinds, William L., Capt., USAF

### American Board of Surgery

Lumpkin, Murray B., Capt., USA
Upp, Charles W., Maj., USAF

# OUR FRONT LINES IN MILITARY MEDICINE

**Guest Editorial by Colonel George E. Leone, MC, USA**

We believe in these days of relative peace our front lines in Military Medicine are in the dispensaries, outpatient clinics, and medical examining facilities. It is here where we make initial contact with patients and others for whom we provide health services. It is in these front lines where we treat the majority of people we serve. Just like the general practitioner is in the front line of the American medical profession, so it is with our medical officers who take sick call, work in dispensaries, outpatient clinics, and examining stations. Important decisions and actions take place in these front lines of medicine. Perhaps some of the everyday medical decisions that are made may not seem important to physicians who may champ at the bit to be in the operating suite or delivery room, but to the individual soldier and members of his family these everyday decisions *are most important.*

Our experience over the past 30 years leads us to believe that we can satisfy the bulk of medical needs of our soldiers and their families through our dispensaries, outpatient services and clinics. We believe one answer to the problem of the high cost of medical care is more well-trained general practitioners in our outpatient services. Give the well-trained medical officer, who corresponds to the best general practitioners, the equipment, office space and properly trained assistants he needs and we can treat the majority of people at a minimum cost. When the patient is admitted to the hospital he sees specialists and the costs go up. Let us not make the mistake of using our medical officers in dispensaries and outpatient areas as just doctors to point out where the soldier patient is to go to get the treatment he needs. If this well-trained general practitioner has the knack of good human relations—combined with skill, good judgment and a knowledge of soldier psychology—then he will save us money and a lot of grief. Many years ago our "attending surgeons" did these duties so well they were held in high esteem by military post population. The easiest but most expensive method of handling a patient who seeks medical care and advice at sick call, in the dispensary or outpatient clinic, is to admit him to the hospital.

The newly inducted soldier; the enlistee; the six months' trainee; the ROTC student in summer camp; and the reservist or member of National Guard during active duty training, may get his first experience with Army medical facilities at the dispensary or examination station. New officers who report to their first station learn by personal experience or through their wives and children what the Army Medical Service is.

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From the Fifth U. S. Army *Medical News Letter,* 10 April 1959. Dr. Leone is surgeon, Headquarters, Fifth U. S. Army, Chicago, Ill.

We have heard of "front men" in big business and organizations and know they place their best foot forward when coming in contact with the people they serve. Accordingly, commanders of Army medical activities would do well to place their best people in these front lines of medicine. We know, of course, that many of our young physicians have just come out of internship and residency, and to their lot falls much of this front line medicine. In order to achieve desirable levels of patient satisfaction our young physicians need careful guidance by experienced medical officers who understand soldier psychology and the needs of their families. In general these young physicians have done an outstanding job and will continue to do so. But they may be disappointed in the routine daily chore of seeing seemingly well people or patients who gravitate toward the "medics" when the going gets rough.

At our large training camps, faced with arduous training schedules and barracks life, with little time for recreation, our young soldiers seek "fathers" and "mothers" in our physicians and nurses and their able assistants. Such high-sounding descriptions like the "nestling complex" will not solve the problem of the human being who presents himself for medical care at a dispensary or clinic. Somebody in the Army Medical Service chain will have to see him as a patient, examine him, prescribe for him if necessary, or make a decision that he is fit for work—duty—or training—whatever his assigned task. Soldiers should not be stigmatized with some catch-all phrase or "diagnostic waste basket."

All individuals in the military service have had contact with their respective medical service, even if they never were sick. Physical examinations, immunizations, and profiling are health services we must provide them. We do not mean to infer that we should nurture soldiers to our bosom. Firmness with kindness, is in order. Understanding and sympathy are not incompatible with good medicine.

Such gratuitous remarks to the soldiers or their dependents, "Oh, you here again!" or "What's wrong with you this time?" do not promote good human relations. We have heard of the medical officer who injects his personal experiences into patients' complaints—like the wife of the serviceman who complained of dizzy spells and the doctor replied, "So what, I get dizzy too."

We don't need to worry about the patient who is admitted to the hospital for a gastric resection or a coronary disease; he will get the the best professional care possible. We are concerned with the hundreds of thousands of patients who are seen daily in our clinics and dispensaries. It is here where the "corporate image" or personality of the medical treatment facility is established.

Those of us who review complaints on medical care are well aware that the majority of cases were handled scientifically correct—the

human relations aspect was neglected. Whether we like it or not, we who have elected to provide service as personal as medical care must keep our poise and dignity no matter what the provocation. Once a complaint gets outside the dispensary or clinic, everyone gets in the act; sometimes from the White House on down.

Perhaps we should welcome complaints because it is through them we can improve our services.

If we recognize that our outpatient services and dispensaries are the front lines of military medicine in peacetime, then we are certain that commanders of our treatment facilities will place their first team there. In fact, we believe a commander or director of the medical activity will want to spend a lot of his own efforts in this area.

Aside from the payoff in good relations that a well-run outpatient clinic will give us, there are benefits in the way of better training for our physicians, nurses, corpsmen and others who make the initial contact with patients. Physical appearance, layout, adequate waiting rooms, parking space and personalized approach—all will contribute to the improvement of our Medical Program.

We can think of no better place to start in making our medical facilities the most attractive in the community, professionally and physically, than in the outpatient area.

## INCREASED INCIDENCE OF SMALLPOX BRINGS WARNING

**The following statement by the surgeons general of the military departments is directed to all medical personnel:**

**The increasing incidence of smallpox in various parts of the world is a matter of considerable concern. Not only is there more of the disease in the areas where it has never been stamped out, but outbreaks are occurring in areas which have been free of the disease for years. Smallpox has recently appeared in such widely dispersed areas as Liverpool, Heidelberg, Singapore and Omura, Japan.**

**Medical officers throughout the world should consider the possibility of smallpox whenever they encounter unusual skin lesions, purpuras and fevers not otherwise explained. Careful attention should be paid to the technics of vaccinations and to the interpretation of results.**

**This disease, with a case fatality ratio of up to thirty per cent, has never been conquered and it must be fought vigorously at all times.**

# A Message From the A. M. A.

Man in his restless conquest of new frontiers has made significant progress in the exploration of outer space. Advances in the design of rocket engines, improved fuel for propulsion, effective inertial guidance systems, better aeronautical design of vehicles, and a number of technologic achievements have been used to make space exploration a reality today.

At first thought, free flight, orbital, or satellite journeys are the principal concern of the engineer, the physicist, the astronomer, and the astrophysicist. These groups working together with the electronic engineers have done much to put vehicles in flight and in orbit, and to succeed in sending back to earth valuable information as to the scientific and physical knowledge of space. Using telemetric devices, data have been gathered concerning velocity of flight of the vehicle, density and composition of outer space, temperatures, magnetic and electronic fields, gravitational influences, and radiation effects of the various layers of outer space. Animals have been included as a part of the pay load of some space vehicles and the first attempts at biological studies begun. Recordings of the physiologic effects of space travel on animals have been flashed back to earth.

The American Medical Association, aware of the developments in the fields of space, in 1958 created an ad hoc committee on aeronautics and space to follow the developments in these fields with special reference to the evolution of government agencies and legislation affecting them and to report to the Board of Trustees medical problems concerned. Since that time, on 29 July 1958, the President signed a bill, now known as Public Law 85-568, creating the National Aeronautics and Space Administration that would have an over-all supervisory function in the fields of aeronautics and space. In broad terms, this agency would: (1) plan, direct, and conduct aeronautical and space activities; (2) arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations; and (3) provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

Outer space is generally considered to be that vast area extending from 50 miles from the earth's surface to infinity and includes the larger heavenly bodies and planets, stars, comets, meteors, and fine meteoric dust and other particles. High altitude

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From the Council on National Defense of the American Medical Association. The views and opinions expressed are not necessarily those of the Department of Defense. —*Editor*

exploration has revealed zones of intense radiation, the so-called Van Allen belt, that offers serious radiation hazards to space travelers. It has been necessary to revise the estimates of radiation upward as the result of findings from some of the recent space probes. Research that will lead to the eventual placing of man in space is underway.

There are still a number of highly complex problems that must be solved before a successful manned flight into space and a safe return to earth is accomplished. Tremendous forces are needed to place a vehicle in space. A velocity of 16,560 miles per hour is required to attain an orbit about the earth. To reach the moon, an escape speed of 25,200 miles per hour must be achieved. It is readily apparent that speeds of this magnitude place great stress on animals or human beings, and necessary precautions must be taken for the safety of passengers during flight. Upon return to the earth, it will be necessary to slow the vehicle down to a reasonably slow speed for a safe landing. Proper protection of personnel during these periods of acceleration and deceleration is under intensive study by a number of agencies.

Sufficient progress has been made so that the actual construction of a cabin in which a human being could make a space flight has been undertaken. The problems of a person confined to a small space are not new ones, and many of the experiences gained in submarine work have furnished the starting place for the space cabin studies. Limitations of weight and cubical contents pose troublesome problems in attempting to solve the difficulties of maintaining proper temperature, humidity, and avoiding auroral, cosmic, and radiation hazards. Significant advances have been made in the control of respiratory, excretory, and nutritional needs of the space traveler, though much still remains to be done. Attempts to study weightlessness and its effects on animals and human beings have been made for brief periods. Spacial orientation is under scrutiny by a number of research workers and influences of a new environment on this problem also are being reviewed. Psychologic attitudes and the effects of travel in a small closed container for a long period of time have been subjected to rigorous experimentation. Changes in chemical reactions in outer space and the influence of radiation effects are still vague, but receiving attention of those in this field.

Suggested methods of testing applicants for space travel will probably entail a series of complex tests. Mock-up space chambers have been used; trials of weightlessness explored, although for very short periods; and psychologic profiling, physical examinations, and other tests are being explored. The second International Symposium on the Physics and Medicine of the Atmosphere and Space, held at San Antonio, Texas, 10-12 November 1958, was an unusual review of the many advances made and complex problems of space medicine that are still unsolved. An

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even greater number of scientists met last month in Los Angeles, California, to hear more than 150 papers in this fascinating field at the 30th annual meeting of the Aero Medical Association which, in keeping with the times, changed its name to the Aerospace Medical Association.

Industrial hazards in using highly flammable propulsion fuels, launching of vehicles, and handling of the complex and intricate mechanisms of space ships follow fairly closely the accepted practices of industrial medicine.

While aeronautics and space is still a new field, there are many problems of a medical nature. The American Medical Association, through its special committee and through other departments, will endeavor to keep abreast of developments in this new and intriguing field. Applications of these studies to the military are apparent and it will be a matter of time until the benefits to civilian life, such as long-range weather predictions and improved world-wide communications are realized.

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## UNIVERSITY OF MINNESOTA HONORS COL. LAY

Colonel Frances I. Lay, Chief of the U. S. Air Force Nurse Corps, received an Outstanding Achievement Award from the University of Minnesota during the 50th anniversary celebration of its School of Nursing, 7 May. Colonel Lay received her bachelor's degree in nursing education at the University of Minnesota in 1951.

Entering the military service in 1939 as a graduate of the General Hospital School of Nursing in Greenville, S. C., Colonel Lay served as chief nurse at Randolph Air Force Base and the 160th General Hospital in Europe during World War II.

*Colonel Lay*

In 1951, as chief nurse at the Gunter Air Force Base Branch of the U. S. Air Force School of Aviation Medicine, she directed the training of newly commissioned Air Force nurses and flight nurses. She served as a flight nurse in Korea, during the Korean conflict.

# CORRESPONDENCE

## HOSPITALIZATION IN INFECTIOUS MONONUCLEOSIS

*To the Editor:* The article "Rupture of the Spleen in Infectious Mononucleosis," which appeared in the January 1959 issue of the *U. S. Armed Forces Medical Journal,* ended with this sentence: "The question of hospitalization in infectious mononucleosis, because of the danger of splenic rupture, is raised."

This question can be resolved for medical officers in the Armed Forces. Since military personnel may be expected to be physically active, they *should* be hospitalized whenever a diagnosis of mononucleosis is made because splenic rupture may be precipitated by trauma and even by physical exertion. Furthermore, if splenic rupture occurs while the patient is hospitalized, a fatality may be averted.

Almost all patients with mononucleosis are febrile and sick enough to warrant excuse from duty. In some instances, a "quarters" status may be more practical than hospitalization. Even in such instances, it might be advisable to hospitalize the patient between the tenth and twenty-first day after onset of illness because splenic rupture usually occurs during this period (if the onset of mononucleosis has been reliably determined).

The incidence of mononucleosis is not so great that "it is not feasible or practicable to hospitalize all patients with the disease." It is feasible. I have been hospitalizing all military personnel with this disease for over a decade; and the spleen of one of my patients ruptured during hospitalization.

ROBERT J. HOAGLAND, Col., MC, USA
Martin Army Hospital
Fort Benning, Ga.

*Colonel Hoagland's letter was referred to the authors of this article whose reply follows:*

We fully agree with Colonel Hoagland's comments as they apply to military personnel. Our statement regarding the feasibility of hospitalizing all patients with infectious mononucleosis applied chiefly to the practice of medicine in civilian life.

JAMES GARFIELD, Capt. USAF (MC)
JAMES H. GENTRY, Capt. USAF (MC)
U. S. Air Force Hospital
Lowry Air Force Base, Colo.

# Book Reviews

THE YEAR BOOK OF DRUG THERAPY (1958-1959 Year Book Series), edited by *Harry Beckman,* M. D. 569 pages. The Year Book Publishers, Inc., Chicago, Ill., 1959. Price $7.50.

The latest edition of this well-known collection of abstracts is, like its predecessors, effectively arranged and presented. It is larger than last year's edition; a new section on bronchopulmonary diseases has been added and the section on infectious diseases has been significantly increased in size. The 22 major sections contain 493 abstracts from 23 countries and 108 journals. The abstracts are brief and readable, yet faithful to the original articles. Each abstract includes the author's name and that of the facility in which the work was done; the journal reference itself is given as a footnote. The inclusion of black and white graphs, charts and photographs adds greatly to the book's value, as do the excellent author and subject indexes. This book will prove valuable to nearly all physicians and especially to the general practitioner and the internist. It should be included in the library of every hospital. —*RICHARD L. SEDAM, Lt., MSC, USN*

THE HAND, Its Anatomy and Diseases, by *John J. Byrne,* M. D. 384 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $16.50.

The author, attempting to write a new text on the hand, is always at a disadvantage because of the excellent coverage of the subject already available. This is especially true in view of the popularity of the editions of Bunnell's *Surgery of the Hand.* The present volume roughly parallels in outline the latter work and from it and others the author apparently has borrowed freely. The coverage given various subjects is clear and the organization is good. The book is divided into five parts: structure and development, infections, trauma, diseases, and reconstruction. The recommendations for treatment follow along well-established lines. The chief appeal of this volume is the good organization and presentation of essential detail in a concise manner.

—*JOSEPH R. CONNELLY, Capt., MC, USN*

POLIOMYELITIS. Papers and Discussions Presented at the Fourth International Poliomyelitis Conference, compiled and edited for the International Poliomyelitis Congress. 684 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1958. Price $7.50.

This book is an outstanding example of the role poliomyelitis has played as a bellwether in leading us to the broad knowledge of virology. Over a half of the discussions are devoted to basic studies in the etiologic agents, not only of poliomyelitis but of also related viruses and in the science of virology in general. The remainder of the book, aside from the reports of the national delegates, is devoted to new work in the care of patients, in rehabilitation and in the social aspects of the disease. Here again a great deal of basic research is

presented to back up the findings of the clinicians. The developments in knowledge of physiology and pathology reported are of import far beyond the limits of poliomyelitis. The striking contrast between the report of the First International Conference in 1949, and the fourth in 1957, shows very well the phenomenal growth of the stature of the various disciplines represented. The book is also full of hope for the future for the patients now under care, for those who may acquire this disease later and for the many in whom the disease will be prevented by the developments which take place faster than they can be reported. It is recommended reading for all who are concerned with any of the aspects of poliomyelitis and for all who are involved in multi-faceted co-operative endeavors. —*JOSEPH W. COOCH, Lt. Col., MC, USA*

VIRAL AND RICKETTSIAL INFECTIONS OF MAN, edited by *Thomas M. Rivers*, M. D., and *Frank L. Horsfall, Jr.*, M. D. 3d edition. 967 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1958. Price $8.50.

The extensive revisions incorporated into the third edition of this excellent volume make it essentially a new book. Commensurate with the advances in knowledge of the past six years, it is larger than its predecessors but it has been kept to a size reasonable to meet the needs of graduate students in the biological sciences and medicine. A natural dichotomy exists within the volume. The first eleven chapters might well stand alone as a formulation of the science of virology without particular attention to the purely medical aspects of the discipline. Here may be found detailed discussions of the chemical and physical properties of viruses, biochemistry of the virus-infected cell, and virus-host cell relationships. There is nothing intuitive about this material. It is difficult and is presented without concession, but it is to the credit of both the individual authors and the editors that the chapters are uniformly lucid and understandable to the nonspecialist who is willing to give them the application their scholarship merits. The remainder of the book is concerned with the various viral and rickettsial diseases of man, and the orientation is distinctly clinical. Here is a distillate of experience and common sense that makes the volume outstanding. There are excellent chapters on the Echo and adenoviruses (groups discovered following the appearance of the second edition), poliomyelitis, the Coxsackie virus group, and the viral encephalitides. My only objection to this volume pertains to the system of references which is similar to that in the companion volume on *Bacterial and Mycotic Infections of Man*, edited by Dr. René J. Dubos. The reader is referred to the second edition of the book for references cited in the text but not included in the bibliography of the present edition. With due respect for the excellent chapter, "Principles and Methods of Epidemiology," by Dr. Kenneth F. Maxcy, it is essentially a shortened version of material presented in the Dubos volume. The pages devoted to this chapter could have been utilized to better advantage in making the bibliography complete. Most persons will undoubtedly consider *Bacterial and Mycotic Infections of Man* and *Viral and Rickettsial Infections of Man* an inseparable set, and thus will not lose the benefit of Dr. Maxcy's knowledge.

—*RUSSELL MILLER, Jr., Lt., MC, USN*

HEMOPHILIC ARTHROPATHIES, by *Henry H. Jordan,* M. D. 255 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $8.50.

Hemophilia is a relatively uncommon condition which is associated with a high incidence of orthopedic deformities and disabilities. Articles appear frequently in the literature concerning the diagnostic and medical aspects of this disease, but there is paucity of references in the literature to the underlying basic treatment and rehabilitation of patients with hemophilic arthropathies. This book fulfills a long standing basic need for a ready reference to the principles of orthopedic treatment and rehabilitation of these patients. It does not cover the finite points of differential diagnosis and the medical management of hemophilia. The author presents in detail the essential elements of x-ray technic, interpretation of x-rays, and a completely rational and lucid approach to the treatment of hemophilic arthropathies including primary management, the principles and technics of immobilization, and the correction of deformities of major joints by vividly illustrating the utilization of both casts and braces for this purpose.

Unquestionably, the most effective results of therapy of these patients' deformities and disabilities are accomplished utilizing a team approach to the problem, including physician, physical therapist, occupational therapist, plaster technician, brace shop mechanic, nurse and social worker. The material is presented in such detail as to act as a guide to the necessary co-ordinated function of any team of selected specialists responsible for the care of these patients. All major points concerning x-rays, casts, braces and the management of the patients are well illustrated by x-rays, diagrams, pictures and charts. Detailed case histories furnish a vivid synopsis of 10 years of extensive experience in the management of over one hundred patients with hemophilic arthropathies. With this book as a guide, more effective management and rehabilitation of these severely disabled patients can be reasonably expected.

—*LLOYD W. TAYLOR, Col., MC, USA*

SYSTEM OF OPHTHALMOLOGY. Volume 1, The Eye in Evolution, edited by Sir *Stewart Duke-Elder,* G. C. V. O., M. A., LL. D., Ph. D., D. Sc., M. D., D. M., F. R. C. S., F. R. C. S. E., F. A. C. S., F. R. A. C. S. 843 pages; illustrated. The C. V. Mosby Company, St. Louis, Mo. 1958. Price $27.50.

This is the first volume of a new *System of Ophthalmology* which will eventually replace the seven volume *Textbook of Ophthalmology* for which Duke-Elder is justly famous. In the new system of 15 volumes the author will be assisted by his colleagues at the Institute of Ophthalmology in London. Presumably this will result in more rapid publication of the series in order that the older volumes one, two and three, which have long been out of print, may be brought up to date and made available.

This first volume will be welcomed by all visual scientists, because this material on evolution of the eye has never been gathered

together before, and because Sir Stewart has elected to write this volume himself. This book, in addition to being scientifically fascinating, is written in the delightful literary style in which he has no peers. The book begins with the effect of light on living organisms, then the evolution of the visual apparatus of invertebrate eyes, the eyes of protochordates, vertebrates, cyclostomes, fishes, amphibians, reptiles, birds, and mammals. It then covers the function of the eyes of animals, including reaction to and perception of light, perception of color, perception of form, and the perception of space. It closes with additional evolutionary data including a discussion of median eyes, rudimentary eyes, luminous organs and electric organs of fishes.

This is an especially useful book for the investigator using animal eyes. The anatomy, histology, refractive error and visual capability of the commonly used laboratory animals are included. A particularly thoughtful touch is the inclusion of marginal illustrations of the various animals under discussion. It would be a rare individual who would recognize most of them by name alone. The many illustrations, both black and white and in color, are of excellent quality. The arrangement of the material is logical and the index is adequate. While this book is not required in the practice of clinical ophthalmology it will aid the clinician in giving a better background in eye development and function. It is certainly a required volume for the research worker, for medical libraries, and serious students of ophthalmology.

*—VICTOR A. BYRNES, Brig. Gen., USAF (MC)*

GLAUCOMA, Transactions of the Second Conference, December 3, 4, and 5, 1956, Princeton, N. J., edited by *Frank W. Newell*, M. D. 245 pages; illustrated. Sponsored by the Josiah Macy, Jr. Foundation, New York, N. Y., 1958. Price $4.95.

This volume is a record of the Transactions of the Second Conference on Glaucoma, held on December 3, 4, and 5, 1956 at Princeton, New Jersey, and brilliantly edited by Frank W. Newell, M. D.

The main purpose of this book is to stimulate glaucoma research. Other objectives are to give the historical background of mechanisms concerned with aqueous formation, to present the glaucoma problem from the standpoint of how increased tension in the eye causes damage to vision and visual fields, often to a degree causing blindness, the mathematical formulation of aqueous dynamics and the technic of applanation tonometry. The manner of presentation is informal, with many questions and answers and long discussions by various authorities. The list of those that participated in this conference is a list of "who's who" in the field of glaucoma. In addition, there were several distinguished foreign visitors. The book is easy to read and well illustrated by pictures, drawings, graphs and tables. The technic of applanation tonometry is excellently described and illustrated. The bibliography is an outstanding bibliography on glaucoma. This book is recommended for use by residents in ophthalmology, opthalmologists, and researchers in the field of glaucoma research.

*—AUSTIN LOWREY, Jr., Col., MC, USA*

PRACTICAL DERMATOLOGY, by *George M. Lewis*, M. D., F. A. C. P. 2d edition. 363 pages; illustrated. W. B. Saunders Company, Philadelphia, Pa., 1959. Price $8.

There has been a distinct effort to bring the second edition of this text up to date without expanding greatly its over-all size. The number of plates has been increased to 121 and the illustrations to 555. A chapter dealing with introductory material about basic sciences in dermatology has been added. Each disease entity is discussed from the standpoint of symptoms, physical findings, pathology, prognosis, and treatment in a very concise manner and supported by pertinent illustrations. Little space is given to the anatomy, physiology and chemistry of the skin as these are beyond the intended scope of the book. In the preface of this edition, as well as in the first, Dr. Lewis states that his purpose is to design a text for medical students, a practical guide for general practitioners, and an aid in orientation for other specialists. He has accomplished his purpose most effectively and has presented his subject matter in a straightforward, lucid manner. This book is highly recommended for use by those for whom it was designed and should be among the standard reference volumes on the subject of dermatology in all medical libraries.

—*JOHN W. ALBRITTAIN, Capt., MC, USN*

PRACTICAL BLOOD GROUPING, by *F. Stratton*, M. D., D. Sc., D. P. H., and *P. H. Renton*, M. D., B. Sc. 331 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $9.

At first this volume appears to be "another book on blood grouping!" in as much as a number of such books or manuals have been published recently. After exploring the book, however, many things not only of general and specific interest but also of very practical value were found. It was this realization that pointed out that the title of the book belies its contents. Certainly its true value is in practical blood grouping but then there is much more material in it of equal or greater importance. It is not a text for the neophyte blood bank technician, nor will it probably satisfy the dedicated investigator in the field of immunohematology. It will be of extreme value to that group of clinicians, pathologists, hematologists and others who require more than the average intelligence in this field. The authors have divided their book into 14 chapters plus an appendix containing sometimes hard to find and useful blood group frequencies. Each chapter contains references to pertinent original publications. The first two chapters present material relative to the factors involved in red cell agglutination tests, including the antiglobulin or Coombs' test and the causes and recognition of false reactions and subsequent ones discuss the ABO blood groups and practical considerations of their determination. There are two chapters on the Rh blood group system and the organization of an antenatal testing service, and three chapters devoted to a thorough discussion of the cross-match test, blood grouping difficulties in acquired hemolytic anemia, and the identification of atypical antibodies. In a chapter

summarizing briefly the seven recognized blood group systems, other than the ABO and the Rh and a brief note on the family antigens and other rare blood groups, the subject matter is developed in an interesting way. A subject is presented, pertinent points are discussed, and then the authors present their solution as to technic, interpretation, and so on. The reader may not agree with their approach to any one blood grouping problem but the material is there and he may draw his own conclusions. Another interesting and very helpful feature is the inclusion of some 75 problem case histories. If it happened to them it can certainly happen to others and so such histories are real problems and solutions to be remembered.—*JOSEPH H. AKEROYD, Lt. Col., MSC, USA*

PRINCIPLES OF PERIPHERAL VASCULAR SURGERY, by *S. Thomas Glasser*, M. D., C. M., F. A. C. S., F. A. S. A. 410 pages; illustrated. F. A. Davis Company, Philadelphia, Pa., 1951. Price $12.50.

In a thorough manner, this volume covers the field of peripheral vascular surgery. It is arranged in a logical and concise manner. The chapters on sympathectomy and the venous system are particularly well done. The rarer peripheral vascular diseases are lucidly discussed and treatment modalities well outlined. This book will be of value to the busy surgeon for quick review of any phase of peripheral vascular surgery. Surgical residents will find this volume of great interest because physiology as well as treatment is thoroughly discussed. The extensive bibliography at the end of each chapter makes this an excellent reference book. High recommendation for use in clinical work should be given to this volume.—*VICTOR C. STRATTON, Capt., MC, USN*

MUIR'S TEXT-BOOK OF PATHOLOGY, revised by *D. F. Cappell*, C. B. E., M. D., F. R. F. P. S., M. R. C. P., F. R. S. Ed. 7th edition, 1201 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1958. Price $14.50.

This is an excellent textbook of pathology for medical undergraduates. It is very well known and widely read in the British Isles but unfortunately has not gained the popularity it deserves in this country. Extensively revised since the last edition in 1951, this is an increase in the number of pages and about 100 more well-selected illustrations of pathological specimens than in the first edition. There is much material on the classification of tumors with ample discussion of the more common types, both benign and malignant, and lesser accounts of the rarer varieties which may present diagnostic problems. The subject of hematology and its relationship with immunology is covered in some detail in this newest edition and this discussion is timely and up to date. There is an entire section devoted to electrolytic balance and fluid due to its great importance in the clinical fields, and an extensive discussion on the endocrine glands and their physiology as related to the pathologic changes. If this text was as well known in this country as in the British Isles, it would be as enthusiastically received. —*JOHN F. McCABE, Capt., MC, USN*

THE PRACTICE OF SANITATION, by *Edward Scott Hopkins* and *Wilmer Henry Schulze*. 3d edition. Foreword by *Abel Wolman*. 487 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1958. Price $8.

The third edition of this book maintains the standards set by the first two editions. In keeping with the rapid advances in environmental sanitation, chapters on food sanitation, milk and milk products, public water supplies, urban sewage disposal, rural sewage disposal, stream pollution, housing air pollution and industrial sanitation have been completely revised or rewritten. The volume covers the various facets of the environmental sanitation in a general, nontechnical manner easily assimilated by lay readers. Detailed information on each feature is precluded by the wide coverage of subject matter in a single volume. Although the new edition reflects a genuine attempt to maintain a degree of completeness and up-to-dateness which is all too often lacking in works of this type, certain coverages are lacking in technical accuracy and current practices; for example, the chapter on insect control does not include the newer insecticides, and there are inaccuracies concerning disease vectors and etiology. However, such minor discrepancies are to be expected in a volume covering such a wide field of subject matter. Although it could hardly be considered a technical reference for industrial physicians or sanitary engineers, it should find a wide field of readers in the teacher, the general student, the nurse and the layman.—*HARVEY G. TOUSIGNANT, Lt. Col., USAF (MC)*

FRACTURE SURGERY, a Textbook of Common Fractures, by *Henry Milch*, M. D., F. A. C. S., and *Robert Austin Milch*, M. D. 470 pages; illustrated. Paul B. Hoeber, Inc., New York, N. Y. 1959. Price $17.50.

This is one of the best and most concise books on fractures that I have encountered. There are four sections to the text. The first covers emergency cases, including splinting, axial malalignments, epiphyseal injuries, healing of fractures, Sudeck's syndrome, reduction of fractures, plaster of paris, compound fractures and regional anesthesia in fracture treatment. It presents the details of traction in a manner which is easy to comprehend. Compound fractures are dealt with from initial management, wound debridement, infected wounds, vascular, nerve, and tendon injuries, to the treatment of skin defects. The chemistry of plaster of paris is probably too detailed for practical purposes. The second section covers fractures of the vertebral column and fractures of the thoracic cage and is complete down to the technic of insertion of Barton or Crutchfield tongs. The remaining two sections deal regionally in a general manner with fractures of the upper extremity and the lower extremity respectively. For surgical details, one would have to refer to a more complete work. This book should be readily available to all interns, surgical residents, general practitioners, and to those especially interested in the treatment of fractures. The principles presented are sound and are acceptable to most authorities in the field of fracture management.

—*ROBERT H. BROWN, Cmdr., MC, USN*

PHYSIOLOGY OF SPINAL ANESTHESIA, by *Nicholas M. Greene,* B. S., M. A., M. D., with a foreword by *John Gillies,* C. V. O., M. C., F. R. C. P. E., F. R. C. S. E. 195 pages, illustrated. The Williams & Wilkins Company, Baltimore, Md., 1958. Price $6.

This volume is a comprehensive review of the literature of the physiologic effects of spinal anesthesia. These effects are compared with those of other commonly used anesthetic agents, whenever applicable, affording the reader an excellent review of normal systems physiology and the alterations caused by most anesthetics, with particular emphasis on spinal anesthesia. Complications of spinal anesthesia are discussed and prophylactic and therapeutic measures are described. The advantages of spinal anesthesia are given in instances where physiologic changes produce valuable diagnostic information or therapeutic effects. Warning is given in instances when spinal anesthesia may cause adverse effects. The review of obstetric physiology is particularly interesting because of the physiologic changes associated with pregnancy and the modified reaction of the patient to spinal anesthesia. The extensive bibliography following each chapter indicates the vast amount of material reviewed and discussed. The index is brief but adequate. This book could be read profitably by any physician who administers spinal anesthesia and particularly by residents in training. It will serve as a useful reference in the library of teaching hospitals.—*ROBERT E. LAU, Col., USAF (MC)*

DISEASES OF LABORATORY PRIMATES, by *Theodore C. Ruch,* Ph. D., with the editorial assistance of *Maryeva W. Terry,* B. A. 600 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $7.50.

This outstanding book, the first of a contemplated series, is a timely and useful volume covering spontaneous diseases of laboratory primates. The author's term "simian primate" differentiates laboratory primates from man and the lemurs, tarsiers and tree shrews. More than 150 photographs, charts and drawings illustrate the 14 chapters on dietary and nutritional diseases, and those of the mouth and teeth, protozoa of the intestinal tract, intestinal helminths, tuberculosis, diseases of abdomen and chest, blood parasites, cardiovascular, nervous, endocrine, reproductive and urinary systems, bone, and skin and neoplasia. Wherever possible, the author has organized the pathologic conditions into regional or systemic categories, presenting the subject matter chronologically in the discussion of infection, incidence, symptomatology, pathology, experimental infection, control and therapy. Each chapter is followed by an extensive bibliography. The volume was written not only for the specialist, but also for investigators maintaining primate colonies. A great need has long existed for a clear and concise text of this type. This volume is highly recommended for anyone engaged in biological research and especially for those interested in the care and management of laboratory primates.

—*HARRY A. GORMAN, Col., USAF (VC)*

DISEASES OF THE NERVOUS SYSTEM. Described for Practitioners and Students by Sir *Francis Walshe*, M. D., D. Sc., F. R. S., with chapters on The Neurological Complications of Liver Disease and Hepatolenticular Degeneration by *J. M. Walshe*, M. R. C. P. 9th edition. 373 pages; illustrated. The Williams and Wilkins Company, Baltimore, Md., 1958. Price $8.

A book that has gone through nine successful editions has obviously met the test of usefulness. It is to be hoped and expected that this smoothly written and reasoned text will progress through many more editions. Intended as a text and reference, this book is well arranged and indexed for ready availability of clinical information. For those who desire to enrich their understanding of particular aspects of neurology, the lack of a bibliography is a distinct weakness. The candid and long overdue statement on "traumatic neurosis" is refreshing, as well as disturbingly accurate. The author shows good judgment in not including the chaotic and presently speculative new material in neurochemistry and neurophysiology, but he would have done well to mention such work.—*PAUL F. EGGERTSEN, Lt. Col., USAF (MC)*

BEHAVIORAL ANALYSIS; Analysis of Clinical Observations of Behavior, As Applied to Mother-Newborn Relationships, by *David M. Levy*, M. D. 370 pages. Charles C Thomas, Publisher, Springfield, Ill. 1958. Price $9.50.

This study began with an attempt to find a better way of determining the presence of an attitude than through a poll of opinions. The observations which were screened for the presence of attitude were limited to small segments of the behavior of a relatively small number of people in a special situation. This author collected and compiled a tremendous amount of material based on observation of the behavior of 19 mothers with their newborn babies. These mothers were observed in a hospital on two or three occasions, starting the moment the baby was brought by the nurse and ending when the baby was taken away. The records were listed for each case in appropriate units and numbers. These units were then viewed by four judges individually, for gradation of positive to negative feelings toward the baby. In addition, the mothers were interviewed through use of a standardized questionaire, and scored to determine ratings ranging from highly maternal to non-maternal. Numerical ratings were given to these ratings. Comparison of the judges' ratings and the ratings on the questionaire revealed a surprising degree of positive correlation. The chapters are written in such a way that the reader can share the author's trials and predicaments in collecting and evaluating the data. The application of this method in the study of other forms of relational behavior is considered. The methods used in this study can and have been applied generally to the study of relational behavior; for example, to the study of mothers and their schizophrenic children during visiting hours or in schizophrenic mothers and their children. This study should aid in understanding the problems involved in the derivation of attitudes from behavior manifested in other social relationships.

—*STEPHEN MOURAT, Lt. Col., MC, USA*

THE DEMONSTRATION CLINIC, by *David M. Levy,* M. D., 120 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.

This short book illustrates a method of instruction of pediatricians, in the study and treatment of the emotional life of the child. For approximately eight years a demonstration clinic has been functioning under the auspices of the New York City Department of Health under the project name of "Attitude Study Project." The introduction is followed by a series of case presentations from a tape recording. Significant footnotes delineate what is going on and make suggestions to the reader about handling similar interview situations. All and all, this is an interesting but not very profound book, particularly applicable for use by those psychiatrists engaged in supervision of pediatric residents, and by pediatricians and those training in the pediatric field. —*JAMES F. DONOVAN, Lt. Col., MC, USA*

SURFACE AND RADIOLOGICAL ANATOMY. For students and general practitioners, by *A. B. Appleton; W. J. Hamilton,* M. D., D. Sc., F. R. S. E.; and *Ivan C. C. Tchaperoff.* 4th edition by *W. J. Hamilton,* M. D., D. Sc., F. R. S. E., and *G. Simon,* M. D., B. CH., D. M. R. E. (Cantab.), F. F. R. 355 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1958. Price $9.50.

In the first revision of this book since 1949, the authors again stress the relationships between anatomic surface contours and their relationships to the underlying body structures as viewed by radiography and dissection. This approach to "living anatomy" is well demonstrated by numerous, accurately illustrated and labeled drawings and radiographs. The correlation between the universally-used methods of physical examination and the anatomic basis for physical findings is emphasized. Individual normal anatomic variations are discussed in regard to each system. Detailed descriptions of technics of all types of examinations are confined to the introductory chapter. In separate chapters, this book combines the detailed anatomy of the human body by anatomic regions. Visible external landmarks, the physical findings related to them and the use of radiographic examination in each of the areas considered, is discussed in relation to the detailed anatomy of the area as seen at dissection. In addition to the excellent reproduction of radiographs, the illustrations of the uses of air and opaque contrast media in radiography are of the highest quality. This book contains excellent demonstrations of the radiographic anatomy of the lungs by bronchography. Other contrast studies of the heart and cerebral vessels are included, and almost every use of contrast material in the radiographic study of human anatomy is demonstrated. This volume is recommended as a basic supplement to standard textbooks of anatomy. It would be of major interest to all students of anatomy, and would serve as a very good basis of reference in the field of normal radiographic anatomy. The easily understandable text and the excellent illustrations could also be used by anatomists and physicians who train technicians in the medical sciences.

—*EDWARD A. SHELDON, Capt., USAF (MC)*

# New Books

Books received by the *U. S. Armed Forces Medical Journal* are listed in this department for the information of readers, and as acknowledgement and appreciation of their receipt from the publishers. Those of greatest interest will be selected for review in a subsequent number of the *Journal.*

NAVY SURGEON, by Rear Admiral *Lamont Pugh,* MC, USN, (Ret.), An Autobiography. 459 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1959. Price $5.

DANGEROUS MARINE ANIMALS, by *Bruce W. Halstead,* M. D. 146 pages; illustrated. Cornell Maritime Press, Cambridge, Md., 1959. Price $4.

INSTRUMENTATION IN ANESTHESIOLOGY, by *William H. L. Dornette,* M. D., and *Verne L. Brechner,* M. D. 242 pages; illustrated. Lea & Febiger, Philadelphia, Pa., 1959. Price $8.

FUNDAMENTALS OF OTOLARYNGOLOGY, A Textbook of Ear, Nose and Throat Diseases, by *Lawrence R. Boies,* M. D. 3d edition. 510 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $8.

SURGICAL PATHOLOGY, by *Lauren V. Ackerman,* M. D., in collaboration with *Harvey R. Butcher, Jr.,* M. D. 2d edition. 1,096 pages; illustrated. The C. V. Mosby Company, St. Louis, Mo., 1959. Price $15.

TOTAL SURGICAL MANAGEMENT, by *James D. Hardy,* M. S., M. D., F. A. C. S. Modern Surgical Monographs. Editor-in-chief, *I. S. Ravdin,* M. D.; Consulting Editor, *Richard H. Orr,* M. D. 292 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1959. Price $9.50.

GYNECOLOGIC ENDOCRINOLOGY, by *Gardner M. Riley,* Ph. D., with a foreword by *Norman F. Miller,* M. D. 330 pages; illustrated. Paul B. Hoeber, Inc., New York, N. Y., 1959. Price $8.75.

HEADACHE, Diagnosis and Treatment, by *Arnold P. Friedman,* M. D., and *H. Houston Merritt,* M. D. 401 pages; illustrated. F. A. Davis, Publishers, Philadelphia, Pa., 1959. Price $8.

THE HISTORY AND PHILOSOPHY OF KNOWLEDGE OF THE BRAIN AND ITS FUNCTIONS, An Anglo-American Symposium, London, July 15-17, 1957. Edited by *F. N. L. Poynter,* Ph. D., F. L. A. 272 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.50.

THE CHILD WITH A HANDICAP, A Team Approach to His Care and Guidance, edited by *Edgar E. Martmer,* M. D., with 27 contributors. 409 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $11.

TRENDS IN NURSING HISTORY, Their Social, International, and Ethical Relationships, by *Elizabeth M. Jamieson,* R. N., B. A.; *Mary F. Sewall,* R. N., B. S.; and *Lucille S. Gjertson,* R. N., B. S., M. A. 5th ed., 522 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $5.

HYPNOSIS IN MODERN MEDICINE, edited by *Jerome M. Schneck,* A. B., M. D. 2d edition. 389 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $8.75.

THE MAMMALS OF NORTH AMERICA, by *E. Raymond Hall,* Ph. D., and *Keith R. Kelson,* Ph. D. Volumes I and II. 1,083 pages; illustrated. The Ronald Press Co., New York, N. Y., 1959. Price $35 for set of 2 volumes.

CIBA FOUNDATION SYMPOSIUM ON THE BIOSYNTHESES OF TERPENES AND STEROLS, edited by *G. E. W. Wolstenholme,* O. B. E., M. A., M. B., B. Ch., and *Maeve O'Connor,* B. A. 311 pages; illustrated. Little Brown and Company, Boston, Mass., 1959. Price $8.75.

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES, Volume 72, Article 12, pages 559-785, March 20, 1959. Editor-in-chief: *Otto v. St. Whitelock.* "The Analysis of Mixtures of Volatile Substances." 126 pages; illustrated. The New York Academy of Sciences, New York, N. Y., 1959. Price $4.

THE YEAR BOOK OF UROLOGY (1958-1959 Year Book Series), edited by *William Wallace Scott,* M. D., Ph. D. 364 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1959. Price $7.50.

1959 EDITION BRITANNICA BOOK OF THE YEAR, The Illustrated Factual Record of Great Events of an Important Year, edited under the direction of *Walter Yust.* 778 pages; illustrated. Encyclopaedia Britannica, Inc., Chicago, Ill., 1959. Price $12.

THE EFFECT OF PHARMACOLOGIC AGENTS ON THE NERVOUS SYSTEM. Proceedings of the Association, December 13 and 14, 1957, New York, N. Y. Research Publications Association for Research in Nervous and Mental Disease. Vol XXXVII. Edited by *Francis J. Braceland,* M. D. 488 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $13.50.

DENTAL CLINICS OF NORTH AMERICA, Symposium on Crown and Bridge Prosthodontics. Consulting editor: *Vincent R. Trappozzano,* D. D. S. 277 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $16.

GLAUCOMA, Transactions of the Third Conference, January 8, 9, and 10, 1958, Princeton, N. J., edited by *Frank W. Newell,* M. D. 272 pages; illustrated. Josiah Macy, Jr. Foundation, New York, N. Y., 1959. Price $5.25.

GROUP PROCESSES, Transactions of the Fourth Conference, 13-16 October 1957, Princeton, N. J. Edited by *Bertram Schaffner,* M. D. 266 pages. Sponsored by the Josiah Macy, Jr. Foundation, New York, N. Y., 1959. Price $4.50.

M.K.P. Myokinetic Psychodiagnosis, by Professor *Emilio Mira Y Lopez,* with a foreword by *Gordon W. Allport,* Ph. D. Edited by *Leopold Bellak,* M. D.; *Michael H. P. Finn,* Ph. D.; *Leonard Small,* Ph. D.; and *Frances Bishop,* B. A. 186 pages; illustrated. Logos Press, New York, N. Y., 1958. Price $6.75.

PEDIATRIC NEUROLOGY, by *Stanley S. Lamm,* M. D. 495 pages; illustrated. Landsberger Medical Books, Inc., New York, N. Y., 1959. Price $12.90.

A SHORT PRACTICE OF SURGERY, by *Hamilton Bailey,* F. R. C. S., F. A. C. S., F. I. C. S., F. R. S. E., and *McNeill Love,* M. S., F. R. C. S., F. A. C. S., F. I. C. S., with chapters by *John Charnley,* F. R. C. S., *William P. Cleland,* M. R. C. P., and *Geoffrey Knight,* F. R. C. S. 11th edition. 1389 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1959. Price $18.

ORTHOPAEDICS IN GENERAL PRACTICE, Is It Rheumatism Doctor? By *W. H. Gervis,* M. A., M. B., B. Ch. Cantab., F. R. C. S. 120 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $3.

HEY GROVES' SYNOPSIS OF SURGERY, edited by Sir *Cecil Wakeley,* Bt., K. B. E., C. B., L. L. D., M. Ch., D. Sc., F. R. C. S., F. R. S. E., F. A. C. S., F. R. A. C. S. 15th edition. 650 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1958. Price $8.50.

NOW OR NEVER, The Promise of the Middle Years, by *Smiley Blanton,* M. D., with *Arthur Gordon.* 273 pages. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1959. Price $4.95.

IN EVERY WAR BUT ONE, by *Eugene Kinkead.* 219 pages. W. W. Norton & Co., Inc., New York, N. Y., 1959. Price $3.75.

KARL MARX: A World Without Jews, edited and with an introduction by *Dagobert D. Runes.* 51 pages. Philosophical Library, New York, N. Y. $2.75.

GENERAL CHEMISTRY, by *W. F. Luder, Arthur A. Vernon,* and *Saverio Zuffanti.* 2d edition. 582 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $6.75.

PHYSIOTHERAPY IN OBSTETRICS AND GYNECOLOGY (Including Education in Childbirth), by *Helen Heardman,* revised by *Maria Ebner,* M. C. S. P. 2d edition. 244 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $5.

THE SCHOOL HEALTH PROGRAM, A Textbook for Teachers and for Professional Personnel in School Health, by *Alma Nemir,* M. D. pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., 1959. Price $6.

GROUP PSYCHOTHERAPY, Theory and Practice, by *J. W. Klapman,* M. D. 2d edition. 301 pages. Grune & Stratton, Inc., New York, N. Y., 1959. Price $4.50.

TUBERCULOSIS AND OTHER COMMUNICABLE DISEASES, by *J. Arthur Myers,* M. D., with 25 contributors. 499 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $14.50.

THE KANSAS DOCTOR, A Century of Pioneering, by *Thomas Neville Bonner.* 334 pages; illustrated. University of Kansas Press, Lawrence, Kans., 1959. Price $5.

RADIATION BIOLOGY AND CANCER, A Collection of Papers Presented at the Twelfth Annual Symposium on Fundamental Cancer Research, 1958, edited by the *staff at the University of Texas M. D. Anderson Hospital and Tumor Institute.* 493 pages; illustrated. University of Texas Press, Austin, Tex., 1959. Price $8.50.

TREATMENT OF LUNG CAVITIES AND ENDOBRONCHIAL TUBERCULOSIS, With Special Reference to Treatment in Malaya, by *Beryl E. Barsby,* M. D., M. R. C. P. 147 pages; illustrated. The Williams & Wilkins Company, Baltimore, Md., 1959. Price $4.75.

A TEXT ON SYSTEMIC PATHOLOGY, Volume II, edited by *Otto Saphir,* M. D., with 8 contributors. 1,950 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1959. Price $38.

SCIENCE AND PSYCHOANALYSIS, Volume II. Individual and Familial Dynamics, edited by *Jules H. Masserman,* M. D. 218 pages. Grune & Stratton, Inc., New York, N. Y., 1959. Price $6.75.

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